NETWORK WORLD
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IBM, Apple deal a boon for net users

By Paul Desmond
Senior Editor

SAN JOSE, Calif. — IBM's alliance spree continued last week as Big Blue and Apple Computer, Inc. announced plans to jointly develop software products aimed at better integrating Macintoshes into IBM nets.

The networking announcement was part of a larger agreement under which the two personal computer industry giants will also develop object-oriented software products and common multimedia software.

In addition, IBM announced it will work with Motorola, Inc. to develop new Reduced Instruction Set Computer (RISC) microprocessors — dubbed POWER PC — which Apple will adopt for its Macintoshes.

The agreement is the second major alliance IBM has announced in as many weeks, coming on the heels of a deal to resell Lotus Development Corp.'s Notes, and the latest in a string of strategic partnerships that include a resale agreement with local-area network market leader Novell, Inc.

"It's a good move for both parties," said Jeff Held, a partner with Network Strategies Practice,

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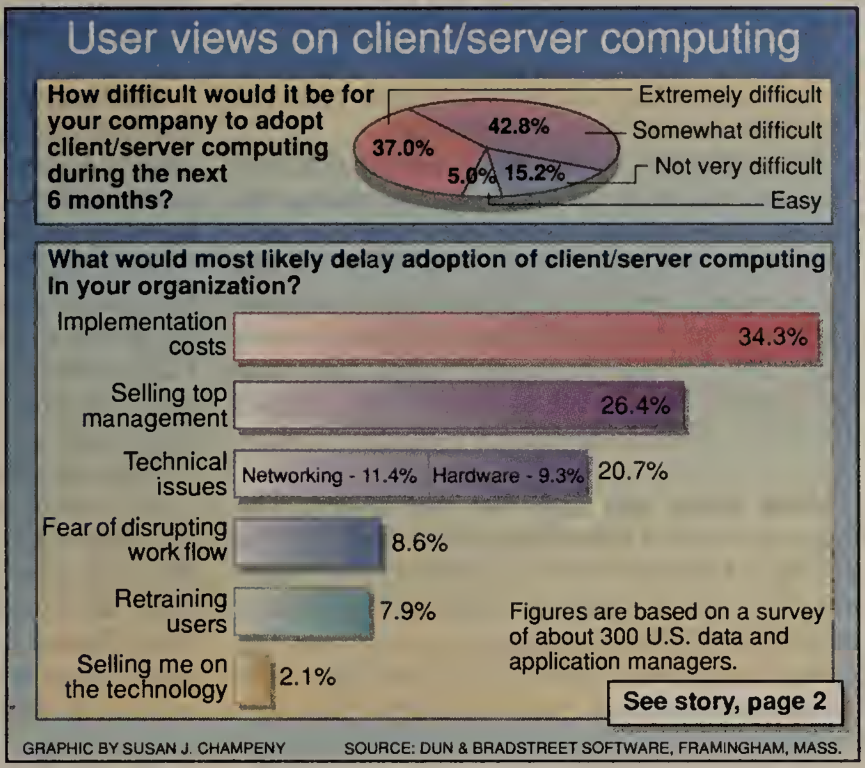
User views on client/server computing



Figures are based on a survey of about 300 U.S. data and application managers.

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GRAPHIC BY SUSAN J. CHAMPENY SOURCE: DUN & BRADSTREET SOFTWARE, FRAMINGHAM, MASS.

Major 5-year IS initiative positions UPS for the '90s

By Barton Crockett
Senior Editor

MAHWAH, N.J. — While most companies have upped network and information systems (IS) expenditures over the past couple of years, few have increased their spending as much as United Parcel Service of America, Inc. (UPS).

In what might be dubbed the mother of all IS expansions, UPS has increased its annual IS budget over the past five years from $40 million to $300 million and has expanded the number of IS employees from 318 to more than 1,400. During that time, UPS developed a suite of new applications for its core business operations and deployed a new data network that supports the company's far-flung global empire.

Officials said the expansion has enabled UPS to better serve customers in the competitive package shipping business. Observers said UPS has gone from a company that underinvested in computing and networking in the early 1980s to one that is trying

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Telecom SWAT team tackles CCS7 mystery

Experts assemble to determine cause of signaling network failures that hit Bell Atlantic and PacBell.

By Anita Taff
Washington Bureau Chief

WASHINGTON, D.C. — For the second week in a row, Bell Atlantic Corp. and Pacific Telesis Group experienced outages related to Common Channel Signaling System 7 (CCS7), triggering still more questions about the vulnerability of the public network.

Experts from the carriers, two switch vendors and Bell Communications Research — the research arm of the regional Bell holding companies — have teamed up and are working around the clock to investigate the cause of the outages.

FCC, Congress to examine problems; users worried about network vulnerability. See pages 4, 6.

Federal Communications Commission officials are also meeting this week to decide whether to open an investigation.

Although they say it is too soon to know for sure, the team of experts coordinated by Bellcore has zeroed in on a handful of possible causes for the outages, including software bugs, capacity limitations of network equipment, security violations and the CCS7 protocol itself.

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INSIDE

Umang Gupta shares LAN data base vision. Page 17.

Brokerage to build on-line clearance net

By Barton Crockett
Senior Editor

CHICAGO — The Board of Trade Clearing Corp. last week disclosed plans to cut over by year end an LU 6.2-based net that will enable brokerage firms to submit commodities, futures and options trades on-line instead of waiting 30 minutes or longer to submit them in batch mode.

The network, called A Real-time Communication System (ARCS), will be linked over the next two years to new trading networks that will help the Chicago Board of Trade move to a paperless trading environment.

"Strategically, [ARCS] is very important for the success of automated systems on the floor," said Richard Baker, vice-president in charge of information systems at the Clearing Corp.

"These systems are important for [providing us with a] competitive advantage in worldwide markets," he said.

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NETLINE

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GATEWAY TO UNWRAP peer NOS that lets DOS-based PCs share data, services without a dedicated server. Page 4.

MCI SAYS INTEGRATION of Telecom*USA network proceeding smoothly. Page 9.

DOMINO'S NET EXEC talks about challenges facing users, involvement in state and national user groups. Page 11.

NET'S TOP EXEC DISCUSSES mux maker's new LAN/WAN router, firm's plans for future. Page 13.

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INT'L NET USERS SOUR on global videoconferencing costs, despite substantial service benefits. Page 23.

NEWSPAPER

FEATURE

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Plethora of options makes multiplexer choice tricky

By Daniel Briere
and Bruce Guptill
Special to Network World

Choosing a T-1 or T-3 multiplexer — especially as an anchor for a corporate backbone network — is one of the more important decisions a network manager can make.

The selected multiplexer not only dictates the type of control capabilities available to manage backbone nets, it can also limit future equipment options.

Recent development of standard interfaces, such as those for frame relay and Asynchronous Transfer Mode (ATM), promise to make it possible to mix multiplexing equipment, but most multiplexers are still proprietary.

Because users may be tied to a single vendor for a long time, it's quite natural for them to have some trepidation over which

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DATACOM BUYER'S GUIDE

Pan Am's outsourcing plan grounded by Chapter 11

Vendors balk on bids for five-year, $500m deal until airline's financial future becomes more clear.

By Wayne Eckerson
Senior Editor

NEW YORK — Three months ago, Pan American World Airways, Inc. revealed it was on the verge of finalizing one of the largest outsourcing deals ever. But now, the bankrupt airline has put its outsourcing plans on the back burner, *Network World* has learned.

Vendors contending for the $500 million outsourcing contract have been reluctant to commit to the project until Pan Am's financial future becomes clearer, said Paul Lawrence, Pan Am's vice-president of information systems (IS). Pan Am filed for Chapter 11 bankruptcy in January, and since then, several airlines and travel companies have expressed interest in purchasing all or part of its assets.

As a result, Lawrence said in an interview last week that he has decided to put the outsourcing project on hold until after Pan Am submits its reorganization plan in September. The outcome of the filing will make clear whether Pan Am will continue to exist in its current form or be restructured to meet the needs of creditors.

The first mention of Pan Am's outsourcing plans came in early April when Robert Wagner, Pan Am's chief information officer at

(continued on page 62)

RSA blasts NIST standard for signature algorithms

Proposal would force vendors to retool products.

By Ellen Messmer
Washington Correspondent

REDWOOD CITY, Calif — RSA Data Security, Inc. last week attacked a government proposal for a new digital signature standard, labeling it an albatross for users and vendors.

The National Institute of Standards and Technology (NIST) proposal, which is a variant of the ElGamal signature technique now used in the public domain, would require vendors to retool their products to support the technology. This would jeopardize vendor investments in RSA encryption technology, which has become a de facto standard, company officials said.

Public-key digital signature encryption methods permit users to add their own encrypted signature or seal to encrypted or clear text messages, providing a means of authentication for messages.

In the opening salvo of what is likely to become an industry battle against the proposed federal standard, Jim Bidzos, president of RSA, attacked recent congressional testimony by Raymond Kammer, deputy director at NIST.

Kammer testified that use of the ElGamal technology would be more economical for the government, which otherwise would have to pay royalties for utilizing commercially available public-

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Survey shows users intent on client/server migration

By Eric Smalley
Senior Editor

FRAMINGHAM, Mass. — A survey of Dun & Bradstreet Software customers released last week show that a majority of users will invest in client/server applications during the next 12 months despite a number of technical and nontechnical barriers.

The survey was conducted among members of the application software vendor's user group, which the company said represents 75% of the Fortune 500 companies. More than two-thirds of those surveyed said they plan to buy or build client/server systems in the coming year.

Dun & Bradstreet users said client/server systems will improve access to information, help reduce processing costs and aid in distributing processing across the network.

But the survey also spotlighted obstacles to the implementation of client/server systems — a list topped by nontechnical concerns. When asked to identify the largest obstacle to adoption of client/server applications, more than 34% of those surveyed cited implementation costs.

More than a quarter (26%) of

(continued on page 61)

Briefs

Saturn exec leads factory nets show. A top official of Saturn Corp. will discuss the company's advanced manufacturing network initiatives during the *Network World*/Digital Consulting, Inc. (DCI) Manufacturing Networks Conference, to be held Aug. 12-14 in Chicago. Dave Skiven, Saturn's manager of facilities, systems and manufacturing integration, will present the keynote address at the conference, which features a variety of sessions on the key technology and management concerns shaping manufacturing networks today.

The conference, which also includes an exhibitor showcase, will focus on such issues as making the business case for open networks, computer-integrated manufacturing, factory local-area network strategies and concurrent engineering. It includes speakers from the Corporation for Open Systems International, Digital Equipment Corp., Electronic Data Systems Corp., General Motors Corp., Hughes Aircraft Co., IBM and Johnson & Johnson.

User puts out call for net audit. The Commonwealth of Massachusetts last week said it is seeking to hire three firms to perform a top-to-bottom audit of its network equipment and services in order to identify billing errors and overcharges. The request for proposal follows a less extensive audit the state performed last year on its Centrex services in which it received more than $6 million in credits from New England Telephone and Telegraph Co. for billing errors.

This year's RFP calls for auditors to scrutinize Massachusetts' switched and dedicated voice and data services, as well as charges for leased and rented voice and data communications equipment. The RFP calls for a three-year contract for as many as three firms; fees will be based on a percentage of savings found through the audit.

AT&T signs Mexican fiber net pact. AT&T Network Systems Group last week said it signed an agreement awarded last September by Mexico's national phone company to build a major portion of a fiber network that will link 54 locations nationwide. Telefonos de Mexico S.A. de C.V. has signed on AT&T to provide fiber-optic cable and related components and AT&T Network Systems Espana to supply transmission equipment. Other vendors will participate in the project.

The new network will include 13,500 km (or roughly 8,400 miles) of fiber cabling and will significantly enhance Mexico's long-distance and international network infrastructure by giving users higher quality lines and faster connection speeds than those currently supported. The project is scheduled to begin in September and be completed in 1993.

Network General to buy firm. Network General Corp. last week said its has signed an agreement to acquire Progressive Computing, Inc. (PCI), an Oak Brook, Ill., maker of personal computer-based diagnostic tools for wide-area networks. The pact calls for Network General to exchange one million shares of its stock for all outstanding PCI stock, but it also contains a contingency clause in which PCI may terminate the agreement if Network General's stock price dips below $6 a share by the time the deal is finalized.

Upon completion of the acquisition, PCI will become a wholly owned subsidiary of Network General. Harry Saal, Network General president, said PCI's expertise in such areas as medium- and high-speed WAN testing and analysis of Integrated Services Digital Networks and Signaling System 7 would complement Network General's local-area network diagnostic strengths.

PacBell slates ISDN expansion. Citing growing demand for its Centrex Integrated Systems Integrated Services Digital Network Basic Rate Interface (BRI) service, Pacific Bell last week announced plans to accelerate deployment of the offering. Steve Mickels, Pacific Bell's director for ISDN, said the carrier would equip 53 additional central offices serving 4.1 million lines to support Centrex Integrated Systems by year end. Currently, the service is supported in 35 central offices. The carrier said 175 central offices will support the service by 1994, extending the total to 7.5 million lines — equal to one-half of all its lines.

Later this year, Pacific Bell plans to file a tariff for single-line BRI service, Mickels said. This would enable small and midsize businesses without Centrex service to begin using BRI. Today, ISDN BRI is only available as a Centrex enhancement in a minimum of two lines.

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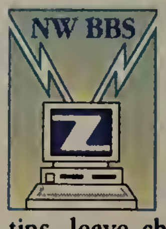

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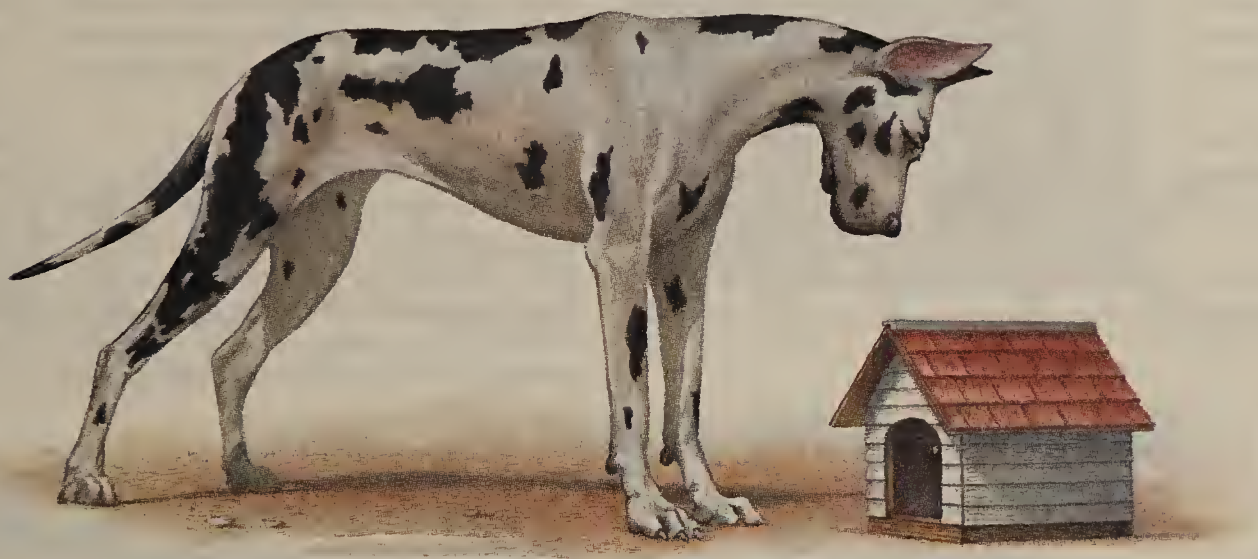

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1988 *Sprint awarded 40% of Federal Telecommunications System 2000 contract. First to deploy SS7 nationwide.* 1990 *Sprint announces the first commercial video services to the Soviet Union.*

Peer-to-peer LAN linked to DOS-based PCs

By Caryn Gillooly
Senior Editor

IRVINE, Calif. — Gateway Communications, Inc. this week will unveil a peer-to-peer local-area network operating system that enables as many as 15 DOS-based personal computer users to share network services and to exchange files and electronic mail without a dedicated server.

Gateway's Great OS network operating system will provide small to midsized businesses with an affordable LAN software choice while giving large corporate net users an economical alternative to installing LAN servers in remote or branch offices.

Great OS will work in conjunction with the company's existing LAN adapters and internetworking products to provide not only standard LAN functionality such as file and print services, but also system management functions such as security, backup capabilities and remote terminal access.

The network operating system, which will be sold through Gateway's resellers, is an OEM version of the Web Corp.'s Web peer-to-peer operating system.

"This year, we saw a big opportunity in the LAN [operating system] market that was not being addressed by Novell, Microsoft [Corp.] or IBM,'' said Bert Ott, vice-president of sales and marketing at Gateway, based here. "That's the main reason we brought this product to market.''

Currently, Great OS works only with Gateway's G/Ethernet and G/EtherTwist LAN adapters, its G/EtherTwist AT Hub Adapter and its IBM Systems Network Architecture, X.25 and Novell, Inc. Internetwork Packet Exchange (IPX) gateways, routers and bridges.

The reason for the limited support, Ott said, was twofold: to satisfy Gateway's current customer base and to have a more controlled hardware foundation for the new product.

"We've built this for now to focus on our customers,'' he said. "And with a new operating system, we wanted as much of a

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Telecom SWAT team tackles CCS7 mystery

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To aid in the investigation, Bellcore has sped up efforts that were already underway to establish a network test bed for multivendor signal transfer points (STP).

According to Don O'Rourke, assistant vice-president of switching technology analysis at Bellcore, the outages may be due to a phenomenon that could be impossible to detect by examining a single STP.

Bell Atlantic, which suffered a serious outage two weeks ago that left about five million customers in three states and the District of Columbia without service for nine hours, experienced back-to-back outages on Monday and Tuesday of last week. The outages, which knocked out local switched service in Pittsburgh, lasted five hours on Monday and two hours on Tuesday.

Pacific Bell also experienced a minor outage last week that blocked 25% of switched voice calls on 2.5 million access lines in San Francisco for five minutes. Two weeks ago, the carrier had a three-hour outage that affected about three million customers in the Los Angeles area. An earlier one-hour outage occurred there on June 10.

The source of the problem

All the network outages occurred when STPs, which direct messages on CCS7 networks, malfunctioned and began to overload the network with error messages, inhibiting the ability of the signaling networks to set up and route calls, according to O'Rourke.

The initial STP problems that triggered the overloads appear to have been different in each case, but all the outages involved STPs manufactured by DSC Communications Corp. in Plano, Texas, O'Rourke said.

Both Bell Atlantic and Pacific Bell had stabilized their networks by last Wednesday by installing software into the STPs that limits the number of error messages that can go out on the network.

There are a number of plausible scenarios that would explain the outages, O'Rourke said, and one of the first the team is examining is the possibility of a software glitch.

"One of the things we're looking at is whether there were any recent software upgrades to the STP that may have contained any undetected critical code errors,'' he said.

"We think this is unlikely since the network slowdowns have occurred in a number of different software configurations for the STP. Nevertheless, we are exploring this possibility,'' O'Rourke said.

A Pacific Bell spokesman said the STPs that failed in Los Angeles used Version 03.01 software and the STPs that failed in San Francisco used Version 03.07.

Bell Atlantic said it had different versions of the software in the STPs that failed and all of its software was of an earlier version than that used by Pacific Bell.

The investigation team is also looking into whether the STPs might have some processing limitation that would cause them to overload under heavier than normal traffic conditions created by the flood of error messages mixing with normal traf-

(continued on page 6)

FCC looking at network outages

WASHINGTON, D.C. — Federal Communications Commission Chairman Alfred Sikes has called for a closed meeting tomorrow to discuss the network outages at Bell Atlantic Corp. and Pacific Bell and to determine what, if any, role the agency can play in preventing similar problems in the future.

At that meeting, Sikes will evaluate the information the FCC's Common Carrier Bureau has learned about the outages through on-site inspections of the facilities and interviews with carriers. The agency will then decide if it should proceed with a formal investigation.

Even before the outages of the past two weeks, concerns about the growing vulnerability of the public network had been increasing.

In Februrary, FCC Commissioner Ervin Duggan sent a memo to Sikes urging a comprehensive review of net security and the adoption of procedures for dealing with problems.

In the memo, Duggan said the FCC has been ineffective in dealing with concerns about network reliability because the commission lacks standard procedures for handling threats or outages.

He suggested the agency institute a broad study into the reliability of the network, establish procedures for investigating major problems and create field teams to explore network outages. The teams would be similar to those used by the National Transportation Safety Board to investigate airline crashes.

Sikes has yet to take action on the memo, but an aide said the chairman may make a statement this week on whether the FCC should become involved in investigating and preventing net problems.

Before leaving for the July Fourth recess, Rep. Edward Markey (D-Mass.) sent Sikes a letter expressing concern about the network outages, requesting the agency submit a report to Congress on the matter by the end of this month.

In addition, sources say that Rep. Bob Wise (D-W.Va) is expected to hold hearings on the issue as soon as this week.

Concerns about network problems were also raised at a hearing on computer and network security two weeks ago when the initial outages occurred.

"Whether through negligence or technological failure, telecommunications in the nation's capital broke down,'' said Rep. Dan Glickman, (D-Kan.), author of the Computer Security Act of 1987. "Computer systems are not being protected adequately.''

Some observers fear future outages could be more serious since the local and long-distance carriers are poised to interconnect their Common Channel Signaling System 7 (CCS7) nets nationwide.

Currently, there is only one such link, a connection between the CCS7 networks of US Sprint Communications Co. and BellSouth Corp. However, Bell Atlantic expects to begin linking its CCS7 network in New Jersey and parts of Pennsylvania to those of the major long-haul carriers next month.

— Anita Taff

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IBM, Apple deal a boon for net users

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a network consulting practice of Ernst & Young in Vienna, Va. "Apple has come a long way in the connectivity business, but they still aren't quite as tightly integrated into the IBM world as they'd like to be."

Apple and IBM announced that they had only signed a letter of intent for the joint development efforts. Actual development is contingent on the completion of contracts in each area, which is expected to occur later this year. New products stemming from the alliance should be available in two or three years.

In the networking arena, the companies laid out a two-pronged strategy for integrating Macintoshes into an IBM client-/server network. The firms will "jointly develop, market and support networking and communications products that further extend the ability of the Apple Macintosh computer to operate in the IBM enterprise environment," the companies said in a prepared statement.

Neither firm would provide any details on the products to be developed. However, an Apple spokeswoman said IBM would market some Apple-developed IBM connectivity products but it has not yet determined which ones.

Apple recently announced software that supports IBM 3270 terminal-emulation and LU 6.2 sessions.

Also, the firms plan to develop an enhanced version of AIX, IBM's version of Unix, that would run Macintosh as well as AIX applications and use the Macintosh or Open Software Foundation Motif user interface. The new version of AIX will run on computers ranging from entry-level Macintoshes to high-end IBM RISC System/6000 servers. Apple will also use the new RISC chip in future Macintoshes intended to run the new version of AIX, the spokeswoman said.

The companies' object-oriented software efforts may also ease multivendor networking through portability of applications. Apple and IBM plan to form a new software company that will develop an "open systems software platform based on object-oriented technology" that will run on machines from laptops to servers. This common platform will support a new generation of applications, as well as current OS/2, AIX and Macintosh applications.

Analysts said the announcements will give Apple more credibility among corporate users and should result in a tighter integration into IBM networks.

"They have claimed IBM connectivity for a while," said Shirley Hunt, LAN industry analyst with Dataquest, Inc., a consultancy in San Jose, Calif. "A lot of people disagreed with them on that."

The agreement could result, for example, in IBM NetView support for Macintosh networks and IBM OfficeVision support for Macintoshes.

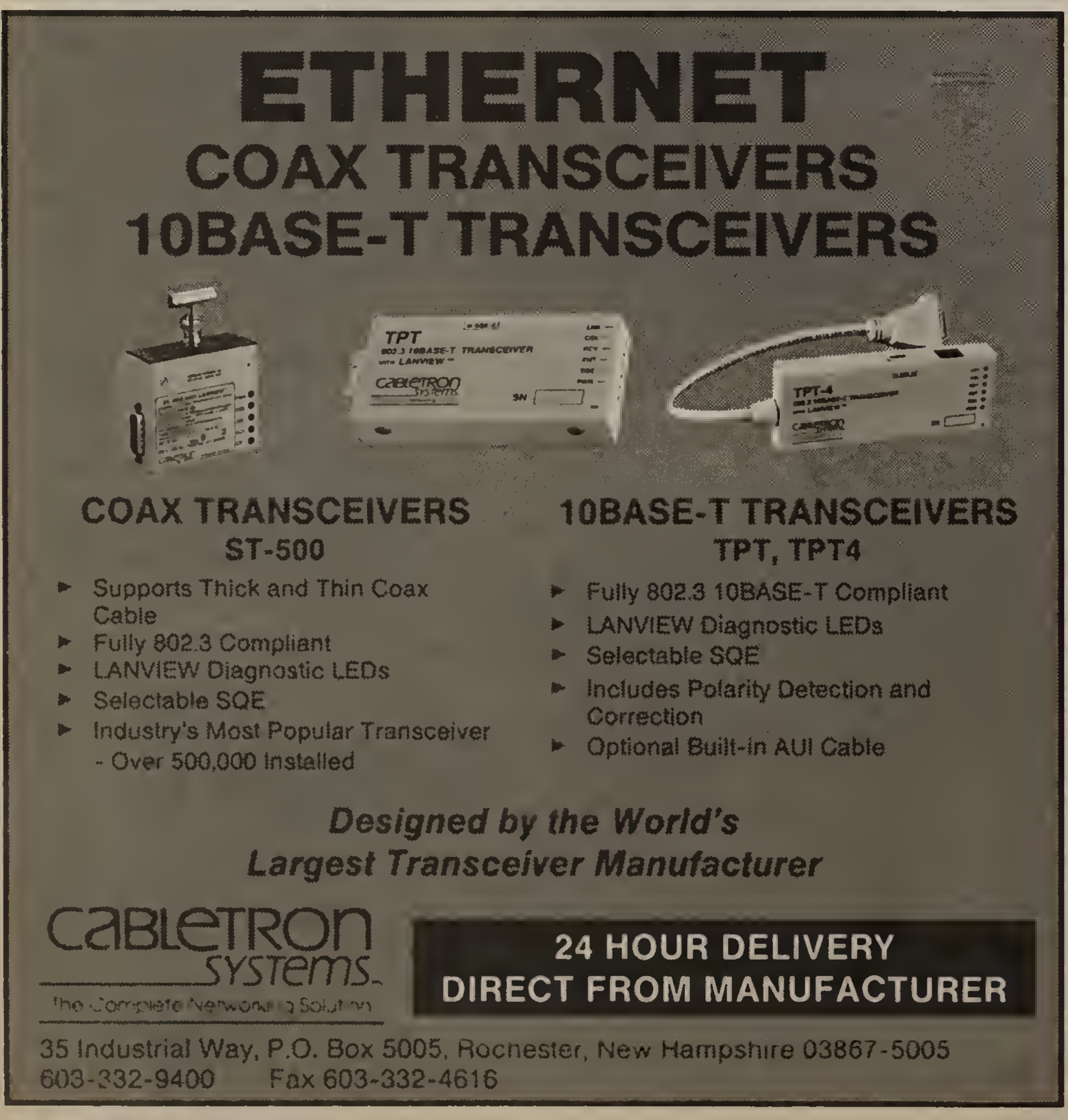
Network Strategies' Held said the AIX announcement fits with Apple's strategy to become a bigger player in the software market. "They really want to be hardware-independent," he said. "One way to do that is to start getting into the Unix base."

According to Hunt, the agreement could improve IBM's multivendor network position. "There are a lot of Macintoshes out there that need to be networked to [IBM] systems. That's an opportunity for IBM," she said.

Users were also enthusiastic about the IBM-Apple alliance. "It would be great for us if this deal goes through," said Michael Descoteau, network specialist at Markem Corp. in Keene, N.H. His company has about 200 Macintoshes and is in the process of replacing two IBM mainframes with IBM Application System/400s.

"We'd need to connect [the Macintoshes] to the AS/400s," he said. "We're now using [Andrew Corp.] KMW [adapter] boards to connect the Macs to the mainframes for file transfer, but it's not at all fast, and it's not really interactive with the users." ▣

Senior Editors Caryn Gillooly and Eric Smalley contributed to this report.



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Telecom SWAT team tackles CCS7 mystery

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fic signaling, O'Rourke said.

Because all of the outages began between 9 a.m. and 11:30 a.m., some have speculated that the disruptions might have been caused by a clock-triggered virus. O'Rourke said the investigating team does not think a virus caused the outages. He is also skeptical that there is anything wrong with the CCS7 protocol itself.

"We don't really suspect the protocol itself, but what we have to do is assure ourselves that every network node, especially the STP, has correctly implemented the protocol, including all of its security, routing and congestion mechanisms," O'Rourke said.

If the cause of the network problems is traced to DSC's equipment or software, other carriers such as Ameritech, which also has DSC STPs in its network, could be at risk.

US Sprint Communications Co. and MCI Communications Corp. also use DSC equipment in their nets, although both carriers said they use earlier versions of the software than those under investigation in the RBHC nets. AT&T uses its own STPs.

The CCS7 outages have unnerved some observers because of fears that as carriers begin to interconnect CCS7 networks, outages could spread, causing a catastrophic nationwide failure.

"We are only now beginning to realize that, as nice as this [SS7] stuff is, we have a loaded gun to our heads," said Paul Kirvan, a principal with Paul Kirvan and Associates, a consulting firm in Turnersville, N.J., specializing in telecommunications disaster recovery.

Carrier officials disagree, saying they have put fire walls in place that would prevent network outages from spreading. US Sprint, which forged the nation's first link between local and long-distance carrier signaling networks by tying its CCS7 network to BellSouth Corp.'s, says adequate safeguards are in place.

"The fact that there is interconnection doesn't automatically mean a problem could spread throughout the network," said Tony Alotto, director of network strategic planning at US Sprint. He said there are physical and software-based mechanisms that would allow each carrier to isolate a failure before it spreads to another network. ▣

Recent BOC outages worry users

By Maureen Molloy
Staff Writer

The recent spate of network outages at Bell operating companies has left users worried about the increasing vulnerability of the U.S. public network and heightened their demands that carriers beef up network redundancy and disaster recovery plans.

The outages suffered by Bell Atlantic Corp. and Pacific Telesis Group — apparently involving their Common Channel Signaling System 7 (CCS7) networks — have especially worried users who rely heavily on the public switched network for mission-critical applications.

"As we begin to deploy more of our most important applications on the switched net, availability takes on much greater significance," said Gerard Monday, manager of corporate information systems at J.C. Penney Company, Inc.

Monday is currently developing a pilot application using Integrated Services Digital Network Primary Rate Interface facilities from a local exchange carrier to link J.C. Penney retail outlets to the company's data center. The application will enable the stores to communicate more cost-effectively than through leasing multiple T-1 lines.

"It's understandable to have problems in implementing any new technology [such as CCS7], but the number of outages reported in the last few weeks is more than I feel comfortable with," Monday said.

Although the Pennsylvania Department of Transportation in Franklin was outside the area affected by Bell Atlantic's problems last week, the department is nonetheless worried about service interruptions.

"We are most concerned about why it takes Bell Atlantic so long to determine the cause of its [CCS7] problems," said Jerry Grabigel, the department's telecommunications manager. "Users would like to know exactly what causes these [incidents] and what the carriers are doing to prevent them from recurring."

One user said the regional Bell holding companies should test new software more thoroughly before implementing it in their networks. "We need to see better quality control on the part of the RBHCs, whether it's their own software that's added to the network or software provided by a third party," said Jim Yeip, senior telecommunications analyst for Federal-Mogul Corp. in Southfield, Mich.

Yeip said he fears that service disruptions like those recently suffered by the two BOCs will continue — and possibly increase in severity. "With sophisticated networks, problems seem to spread quicker, are tougher to isolate and are more difficult to correct," he added.

Most users, however, believe the jarring magnitude of the outages will prompt the BOCs to fortify each switch in their nets and proceed more carefully with future network upgrades.

"This incident is as devastating to Bell Atlantic as the AT&T outage was [in January 1990], so I'm confident they won't let it happen again," said Patricia Graham, vice-president of networking at Mellon Bank Corp. in Pittsburgh.

Mellon Bank was one of about five million customers affected by the Bell Atlantic outage, which disrupted service for as long as nine hours.

Phil Evans, telecommunications director at FMC Corp. in Dallas, said he believes outages will decrease as the technology matures.

"It's still new, and like any other new program, you're bound to run into insidious glitches during deployment," he said. "Many of us users have enjoyed the efficiencies of CCS7 in the form of lower communications costs and increased quality, and have tended to take this complex technology for granted." ▣

Senior Editor Bob Wallace contributed to this report.

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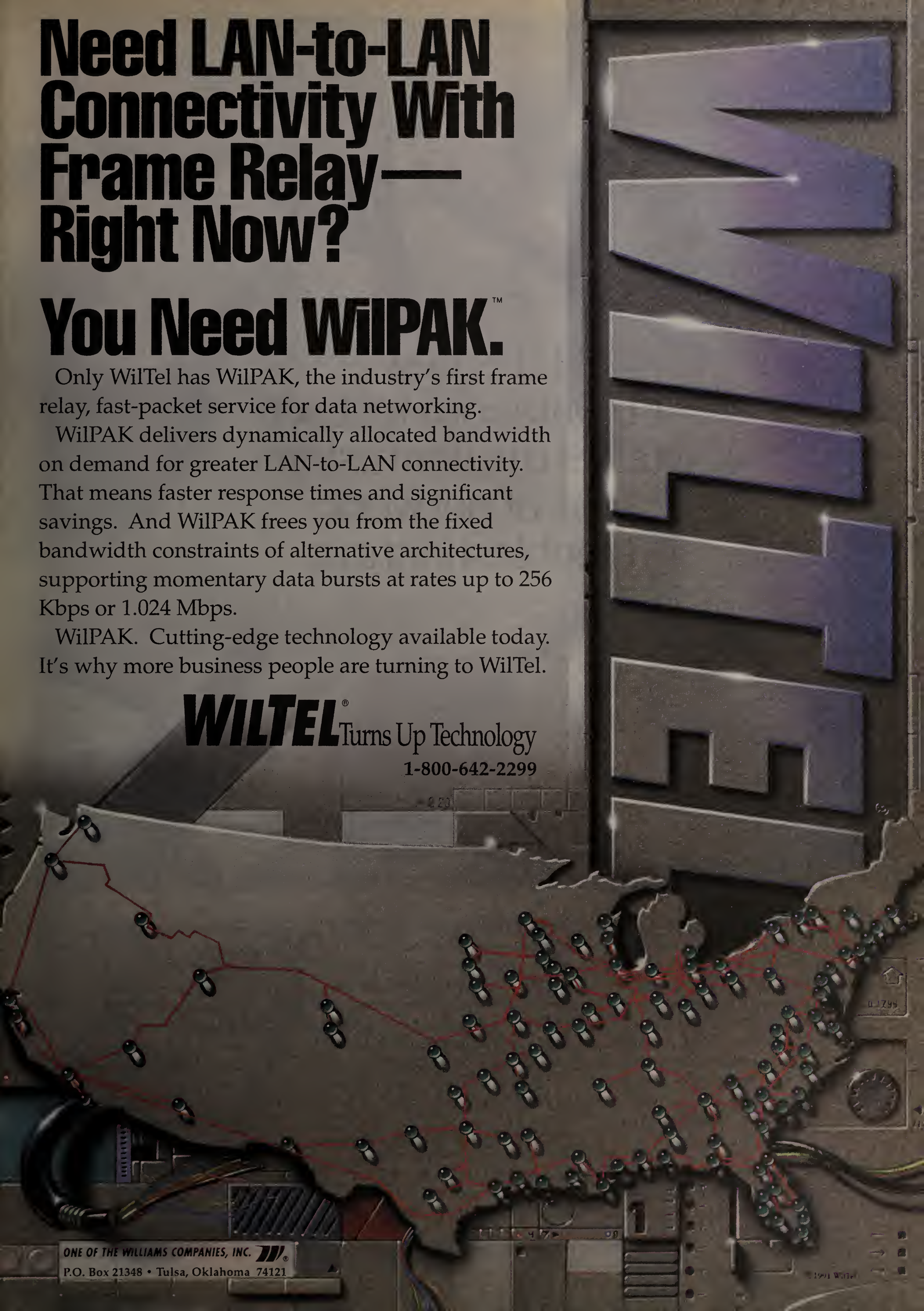

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INDUSTRY UPDATE

VENDOR STRATEGIES, MARKET TRENDS AND FINANCIALS

Worth Noting

"Looking back, MCI's acquisition of Telecom*USA [Inc.] has forced both AT&T and US Sprint to pay more attention to the midsize and small business markets."

Fritz Ringling
Vice-president of
analytical services
Insight Research Corp.
Parsippany, N.J.

People & Positions

William Rahe Jr. has been named to the newly created position of director, private-line and data services marketing at **Cable & Wireless Communications, Inc.**, a Vienna, Va., long-haul carrier.

Rahe will be responsible for managing and developing Cable & Wireless' private network and managed data services. Previously, Rahe was a consultant for CWC Managed Data Services, serving as acting vice-president for engineering and operations.

Karl Hoenig has been named president and chief executive officer of telecommunications equipment distributor **Tel Plus Communications, Inc.**, one of Siemens AG's U.S. companies.

Hoenig comes to Tel Plus, which is based in Boca Raton, Fla., from Siemens in Munich, Germany, where he was responsible for worldwide product marketing for mid-range private branch exchanges. He succeeds **Hans Schromm**, who is returning to Germany to assume an as yet unnamed position at Siemens.

Bruce Simpson, formerly vice-president of finance and administration, has been named president of **Tigon**, a voice messaging service provider. Simpson replaces **John Beletic**, who stepped down for one year to serve on the boards of several companies. ◻

Study foresees rocketing acceptance of info imaging

Predicts the market will grow by 350% annually.

By Ellen Messmer
Washington Correspondent

SILVER SPRING, Md. — The latest study from the Association for Information and Image Management (AIIM) predicts that the information imaging industry will grow from a $3.5 billion market today to more than $12 billion by 1995.

The report, in which Deloitte-Touche surveyed 861 users, stated that the market will grow at a rate of more than 350% annually due to users desire to eliminate vast amounts of paper and improve customer service.

The survey found that respondents spend an average of $849,000 per year on imaging products. Based on input from the trade group's vendors and user members, the report stated that electronic imaging systems now account for 37% of information and image management purchases and will account for 72% of all imaging revenue by 1995.

Purchases of micrographics equipment, which represent 40% of the industry, are expected to shrink to 15% of the expected $12 billion imaging market by 1995.

The study also said services organizations, such as banks and insurance firms, are spending more than manufacturing or government users on imaging products and services. The services group accounted for 57% of the entire $1.3 billion in electronic image management (EIM) purchases in 1990.

"Banking and financial respondents indicate that a primary objective of these purchases is to improve customer service," the report stated. And the need to improve transaction processing is the driving force behind the large EIM purchases.

Banking and financial firms are also leading the charge in EIM purchases. EIM software and computer-based systems, which compress a scanned image for storage and retrieval, are being used for transaction processing.

EIM is expected to dominate the industry by 1995.

The AIIM report concluded that the top three reasons for the manufacturing, services and government sectors to make large EIM purchases are improving record access time, providing better customer service and improving control over paper-intensive processing. ◻

INDUSTRY BRIEFS

DCA sells off 10NET LAN unit. Digital Communications Associates, Inc. last week said it has sold its 10NET Communications business unit to Tiara Computer Systems, Inc. for $2.5 million. DCA also said it purchased, for an undisclosed sum, a 10% stake in Tiara, a Mountain View, Calif., vendor.

The sale marks DCA's exit from the local-area network operating systems market just four years after DCA snapped up 10NET in August 1987 for about $11.1 million.

Andrei Glasberg, Tiara's chief executive officer, said 10NET will enable it to offer resellers a full range of LAN products.

A company spokesman said DCA sold off the unit because its products did not match customer requirements. DCA's peer-to-peer network operating system and LAN adapters are focused primarily on small and midsize companies, while DCA's microcomputer-to-mainframe business specializes in 3270 software and gateways to IBM hosts.

Chipcom forms European arm. Chipcom Corp., a Southborough, Mass., maker of intelligent wiring hubs, recently established a new subsidiary in London dedicated to the sales and marketing support of Chipcom's products abroad. Chipcom Europe B.V. will be responsible for developing a distribution network comprising value-added resellers and systems integrators in Africa, Europe and certain Middle Eastern countries. It will also establish subsidiaries in France, Germany and the U.K.

Peter Hammond will be the managing director of the European outfit.

About 35% of Chipcom's 1990 revenue was derived from sales in the areas to be covered by Chipcom Europe. ◻

"MCI's senior officers were easily convinced that they should not take a parochial view that MCI's way is better than Telecom*USA's way. Telecom*USA was about as unique a company as there was in the telephone industry."

Steven Sheldon
Vice-president,
Telecom*USA, Inc. integration
MCI Communications Corp.
Richardson, Texas

MCI melds nets with Telecom*USA unit

MCI eliminates 70% of unit's leased lines, moves to support Telecom*USA fiber net, applications.

By Bob Brown
Senior Editor

RICHARDSON, Texas — MCI Communications Corp.'s integration of its own network with the Telecom*USA, Inc. net it acquired almost a year ago is proceeding as planned, according to an official overseeing the project.

The interconnection of MCI and Telecom*USA central offices will enable MCI customers to use services offered by either carrier, and will also provide MCI with added fiber facilities to support customer data.

MCI announced plans to buy Telecom*USA, then the fourth-largest U.S. long-haul network provider, for $1.25 billion in April 1990 ("MCI stages $1.25b Telecom*USA buyout," *NW*, April 16, 1990). The deal, which resulted in Telecom*USA being merged into MCI, was finalized last August.

The acquisition was designed to help MCI better compete with AT&T and US Sprint Communications Co. by expanding its customer base among small and midsized businesses, where Telecom*USA captured a healthy amount of business. While Telecom*USA's net was based mostly on leased capacity, MCI coveted the Atlanta-based carrier's 3,000 miles of fiber-optic cable.

"MCI stands to benefit from the Telecom*USA acquisition because of Telecom*USA's success in small business markets," said Daniel Briere, president of TeleChoice, Inc., a Montclair, N.J., consultancy. "But that will only hold true if MCI can figure out how to integrate the networks so both MCI and Telecom*USA services can be offered nationwide. They haven't done that yet."

But MCI is getting close.

Upon making the acquisition, the company formed a team of MCI and Telecom*USA employees to oversee the integration of the two carriers' networks. According to Steven Sheldon, MCI's vice-president of Telecom*USA integration here and previously Telecom*USA's vice-president of engineering, the effort to blend the two carriers' Signaling System 7-based nets has exceeded his expectations, considering the enormity of the task.

So far, about 40% of the traffic traveling over what was Telecom*USA's net has been transferred to MCI's net and the rest is scheduled to be migrated to MCI's net by the end of the first quarter of 1992, Sheldon said.

In doing so, MCI has been able to eliminate about 70% of Telecom*USA's leased capacity, which has resulted in significant cost savings to the carrier, he added.

"To our customers, this means MCI is running much more efficiently," Sheldon said. "Where we still need to lease, the combined buying power of MCI and Telecom*USA enables us to reduce costs, too."

With the leased lines disposed of, MCI can focus on melding the Telecom*USA fiber into its network and modifying software on its central office switches to support services and applications developed by Telecom*USA.

Among these services will be Telecom*USA's Star Card, a travel card that provides customers with access to services, such as voice messaging. MCI's Preferred Service for small business customers has already incorporated some of these features.

To support the consolidation of the two carriers' network capacity, MCI is upgrading the ge-

(continued on page 22)

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TELECOMMUNICATIONS

CARRIER SERVICES, CENTREX, CPE, WIRING SYSTEMS AND BYPASS

Worth Noting

"It's no longer a question of whether users will implement ISDN, it's a question of when they will use it."

Ian Angus
President
Angus TeleManagement Group
Pickering, Ontario

Carrier Watch

AT&T Network Systems Group recently said it will cut the interval needed to fill telephone companies' growth orders — adding additional capacity to an exisiting switch — from 27 weeks to 14 weeks.

The company also announced it has reduced by 25% the time required to engineer and install a 5ESS digital central office switch in a new location.

A 5ESS switch configured to support as many as 20,000 lines can now be set up and operational in approximately 30 weeks.

The two changes will streamline the engineering, furnishing and installation required with 5ESS orders. In addition, they will reduce the amount of time telephone companies require in order to offer 5ESS switch-based services to users.

AT&T was able to make these changes by preconfiguring switch modules that represent those most frequently ordered by telephone companies.

Carriers that order one or two preconfigured modules can have them installed within the reduced interval. Companies that order three or more preconfigured modules, or one requiring a unique configuration, can be accommodated in a slightly longer interval.

AT&T Network Systems' customers have pressed AT&T to reduce order-to-service intervals by using preconfigured modules, said Greg Terry, AT&T Network Systems' business and product management director. ◪

AT&T plans to start PCN service trials in 3 cities

Asks FCC for permission to test technology.

By Anita Taff
Washington Bureau Chief

WASHINGTON, D.C. — AT&T is exploring the possibility of offering a personal communications network (PCN) service and recently asked the Federal Communications Commission for permission to start experimenting with the technology.

AT&T is the first long-distance carrier to consider offering a PCN service, although about 50 other companies, including several regional Bell holding companies, cable television operators and specialty PCN firms, have already applied for permission to trial the service.

AT&T had previously announced interest in providing PCN equipment but had been silent on the issue of providing PCN services. US Sprint Communications Co. is evaluating the possibility of offering PCN, while MCI Communications Corp. has no announced plans for the service.

PCN is a wireless, digital technology that can support voice and data communications as well as advanced network capabilities such as Signaling System 7. Unlike traditional cellular service, PCN is a complete network architecture and could be used instead of the RBHCs' local loop.

An AT&T PCN service could be tied into the carrier's long-distance network to provide end-to-end digital connectivity for users in cities served by the PCN offering. If all standards issues are resolved, AT&T could also link up with other firms' PCN networks.

Unlike most other PCN trials, AT&T is proposing to test the technology in the 6-GHz frequency, which is much higher than the 1.7-GHz to 2.3-GHz range used in other trials. An AT&T spokesman said the carrier already holds a license in the 6-GHz range and wants to determine whether the service can be offered there.

AT&T stated in its PCN application that it wants to conduct a three-year trial in Atlanta, Boston and Los Angeles. This would allow AT&T to test the equipment and technical performance of the network service while determining the types of services users want.

The trial would be conducted in three phases. The first, scheduled to last 10 months, would cover software and hardware development and testing as well as development of techniques needed to share the 6-GHz frequency with users of other wireless technologies without interference.

Phase 2, scheduled to last 14 months, will be a small-scale field trial in one city to further test software and hardware. Installation of equipment in the three cities for the final phase will also be-

(continued on page 22)

WASHINGTON UPDATE

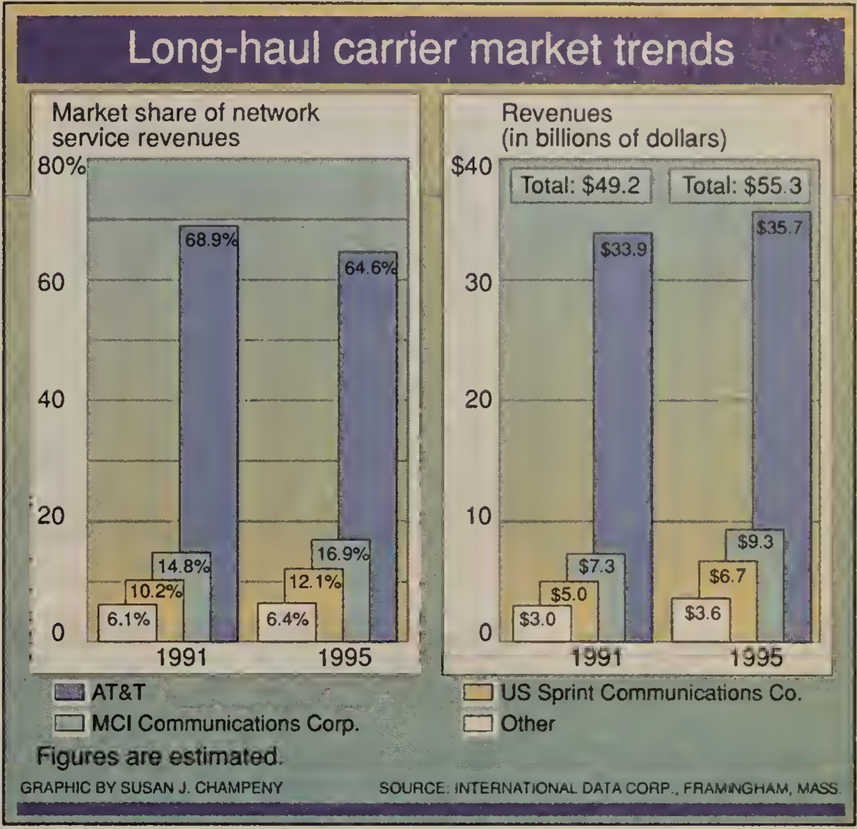
BY ANITA TAFF

Two Tariff 12 revisions await FCC approval. AT&T is awaiting approval from the Federal Communications Commission to reduce minimum annual charges on two more Tariff 12 deals. AT&T has proposed lowering the guaranteed charges on General Electric Co.'s deal by about 1% and reducing charges for MasterCard International, Inc. by about 3%.

The carrier said the change in GE's deal was required because of the firm's revision of its outage credits and basic charge — a nonusage-based fee paid by users for fixed network facilities under Tariff 12. AT&T said the changes to MasterCard's deal reflect a reduction in usage charges.

AT&T raised some eyebrows in April when it proposed cutting by 61% the minimum annual charge on Bridgestone/Firestone, Inc.'s Tariff 12 deal. The drastic cut was necessary, AT&T said, because the firm was having severe financial difficulties and could not meet the guaranteed annual payments.

Opponents complained about the extent of the change, saying it undermined AT&T's assertions that discounted prices offered under Tariff 12 were made possible by volume and term commitments from users. After examining the request, the FCC allowed AT&T to cut Bridgestone/Firestone's charges. ◪


Long-haul carrier market trends

Figures are estimated.

GRAPHIC BY SUSAN J. CHAMPENY

SOURCE: INTERNATIONAL DATA CORP., FRAMINGHAM, MASS.

Domino's exec finds new ways to deliver

Telecom chief Dan Gonos champions change by rallying for caller ID inside, outside his company.

As telecommunications manager for Domino's Pizza, Inc., Dan Gonos created a strategic plan to implement new calling services, winning the support of the decentralized company's top management as well as most of its 1,000 franchise owners nationwide.

In addition, Gonos has given Domino's a high profile in the telecommunications industry through his efforts to help found the National Centrex Users Group and his active role in the Michigan Telecommunications User Group. He also testified before state regulators on the need for caller identification service.

Gonos recently spoke with *Network World* Senior Editor Bob Wallace about the challenges he and other telecommunications managers face today, the importance of user groups and the need for changes in user-vendor relationships.

What are the toughest challenges facing you as a telecommunications manager for a high-profile national company?

The toughest challenges are internal. We're an operation with a large number of franchises, and our style of management is decentralized.

Developing an idea is only half the equation; the other half is trying to sell the idea to the organization and the franchisees. It's a wide and diverse audience.

As a high-profile user, it's very difficult to keep the wraps on anything leading edge for very long. So it's important to sell and implement quickly in order to keep a competitive edge. In comparison, a smaller company with a low profile can operate comparatively undetected.

Dan Gonos

Why is it important for Domino's to have such a high profile in the telecommunications industry?

It's important because we're in something of a unique position. Although as an aggregate, we're large, and any one of our pieces seems relatively small compared to other organizations. We need to be treated as both a big company and a small company. It's sometimes difficult to make vendors understand that.

(continued on page 62)

WHY BRITISH AEROSPACE FLIES WITH GDC.

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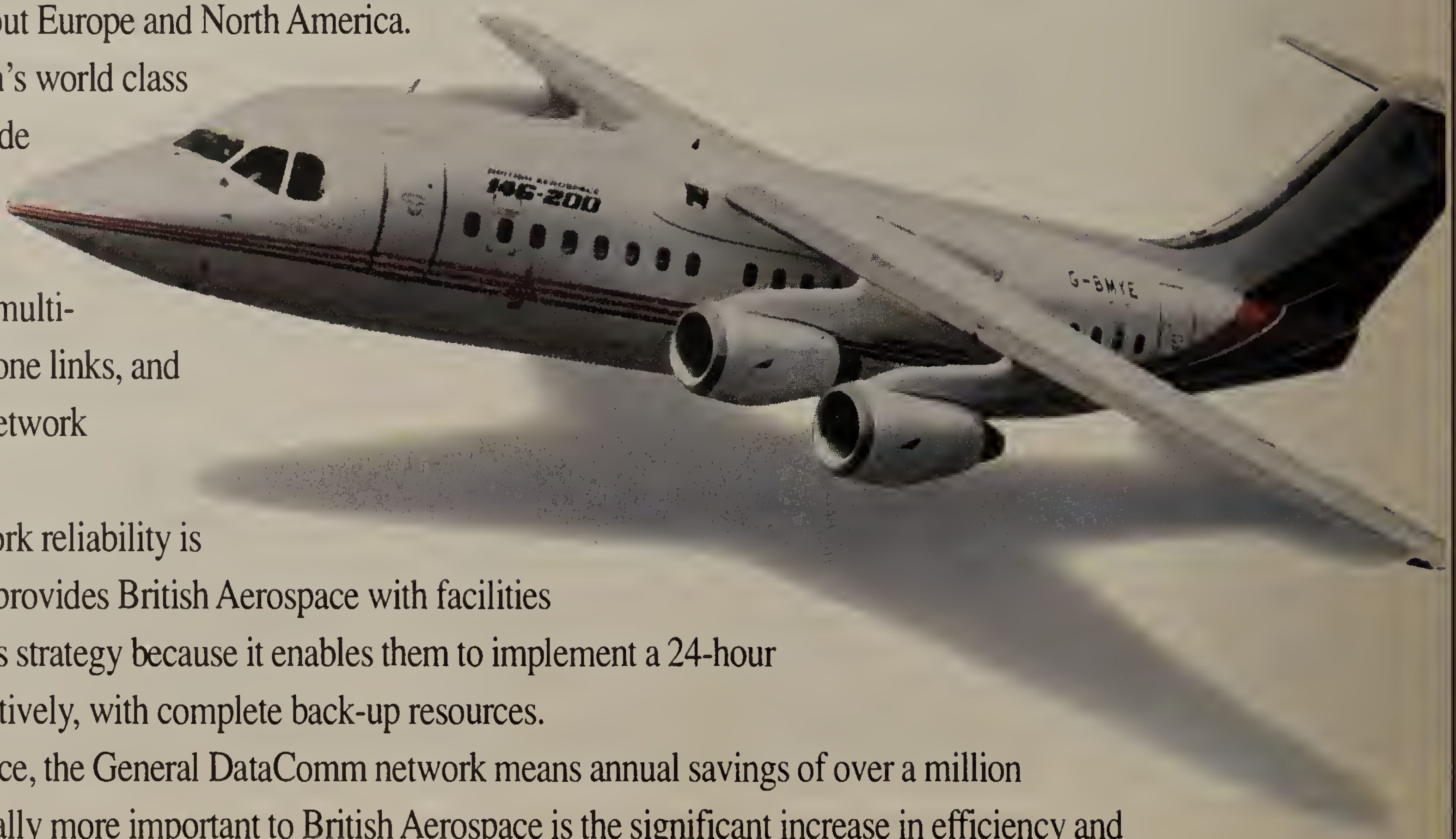

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DATA COMMUNICATIONS

PRODUCTS, SERVICES, ARCHITECTURES, STANDARDS AND NETWORK MANAGEMENT

Worth Noting

"I'm glad to see [IBM] striking up strategic partnerships with successful application vendors. I think it's good for IBM, and it's a win for business users."

Keith Sievers
Treasurer and vice-president
of information systems
Federal Kemper Insurance Co.
Decatur, Ill.

Data Packets

BT North America, Inc. recently announced it will market a full range of videoconferencing products and services in the U.S for multinational user companies.

Initially, the firm will sell two video coder/decoders (codec). The VC 2100 supports videoconferencing at speeds ranging from 56K to 2M bit/sec as well as near broadcast quality video, BT North America said. The VC 2200 supports dial-up videoconferencing at up to 128K bit/sec.

Both codecs are available now. The VC 2100 costs $44,000, while the VC 2200 costs $42,000.

DataComm Management Sciences, Inc. of East Norwalk, Conn., recently unveiled the SFI-256 Satellite Fiber Optic Interface, which provides a fiber-optic interface for the company's MTRX family of matrix switches.

The SFI-256 supports a fiber link between MTRX Satellite units, which, in turn, support the physical attachments for devices linked to the matrix switch.

Using fiber cable as opposed to standard twisted pair extends from 4,000 feet to more than eight miles the total distance between data terminal equipment and data communications equipment attached to a matrix switch.

The SFI-256 is scheduled to be available next month for $9,555.

Firm dumps terrestrial net for dependability of VSATs

Mid-American to link 40 remote sites in 10 states.

By Eric Smalley
Senior Editor

CANAL WINCHESTER, Ohio — Mid-American Waste Systems, Inc., a rapidly growing waste management company, has turned to Scientific-Atlanta, Inc. for a $3 million VSAT network to link 40 remote sites scattered across 10 states.

The very small aperture terminal net, to be completed next month, will replace Mid-American's existing terrestrial leased-line network. The company found the VSAT option to be much more efficient than running land lines out to a landfill at the edge of town.

"If you run landfills and waste management companies, you tend not to be located in the center of town," said Michael Patton, vice-president of information systems for Mid-American. "Consequently, the quality of your terrestrial lines tends to suffer."

When the network is installed, each remote site will be equipped with a 1.8-meter satellite dish connected to a four-port control unit. Each port can be connected to a separate computer, and the network can handle three protocols at one time.

Each Mid-American site has either an IBM Application System/400 or a System/36 that communicates with the other sites using the Synchronous Data Link Control protocol. Mid-American is installing an asynchronous net that will connect microcomputers at each site over the VSAT network. The asynchronous net will provide the company with the means for implementing electronic messaging, according to Patton.

Mid-American is a highly decentralized company with the majority of its applications processed at remote sites, he added.

Mid-American will also reduce its costs by centralizing its systems management, limiting the number of support personnel to five. The technical support staff manages the company's remote minicomputers over the network using customized systems management applications.

Improving the quality of data transmissions is not the only benefit of moving to a VSAT network, Patton said.

"To gain equivalent performance with land lines would be more expensive, even at only 40 sites," he said. "As the number of sites goes up, that break-even point gets better because we can spread some fixed costs over those sites."

DEC rolls out ASA Services to integrate applications

By Paul Desmond
Senior Editor

MAYNARD, Mass. — Digital Equipment Corp. recently unveiled the first products of the Application Control Architecture (ACA) blueprint it announced last December that defines how to build links between applications running on different computer systems.

The new products, dubbed ACA Services, provide facilities for handling communications between separate applications running on DEC VMS- or Ultrix-based machines.

The new offerings are part of DEC's Network Application Support architecture for application integration.

ACA Services is used to forge links between applications, such as integrating plant operations for manufacturers or merging information from separate applications into compound documents in an office environment.

The software has two components. The first is the Developers Kit, which consists of object-oriented tools that help programmers incorporate ACA Services' communications features into existing applications. The other is a Runtime License, which is software that runs on each participating computer and keeps track of links between applications.

With the Developers Kit, users can register applications as authorized to use ACA Services and capable of being invoked by other applications. No application code modifications are required, according to DEC.

Applications communicate with one another using remote procedure calls (RPC), such as the Open Software Foundation's (OSF) RPC. Optional directory services, such as the OSF's or Open Systems Interconnection

(continued on page 61)

"Clients don't want to be constrained to leased T-1 facilities. If that's all you can address, you've got a problem."

Daniel Warmenhoven
Chairman and CEO
Network Equipment Technologies, Inc.
Redwood City, Calif.

NET explains role of LWX packet engine

Exec hints device may support IBM's Advanced Peer-to-Peer Networking to handle SNA routing.

By Paul Desmond
Senior Editor

FRAMINGHAM, Mass. — In the wake of its announcement of a new packet-switching module for the IDNX T-1 multiplexer, Network Equipment Technologies, Inc. (NET) recently mapped out some of the long-term implications of the device.

Daniel Warmenhoven, NET chairman and chief executive officer, said in a recent interview with *Network World* here that the company's new LAN/WAN Exchange (LWX) will be the foundation for several new IDNX features, including Systems Network Architecture routing and the Integrated Services Digital Network Q.931 signaling protocol.

The LWX's packet engine and routing capabilities make it complementary to high-performance routers used to link local-area networks in a building or campus setting, Warmenhoven said, while the packet engine will enable users to make more effective use of backbone bandwidth.

The LWX is a packet-switching module that fits into an IDNX T-1 multiplexer, enabling the IDNX to support both packet-switched traffic, such as frame relay, and its traditional circuit-switched traffic ("IBM fortifies FEPs; NET adds new router," *NW*, June 24). It also runs routing software from Cisco Systems, Inc. to support multiprotocol LAN traffic.

Over time, the LWX will be the foundation upon which NET will support some form of SNA routing. Although Warmenhoven would not disclose how the LWX will route SNA, he hinted that it would be based on IBM's Advanced Peer-to-Peer Networking (APPN). That would be a departure from the way Cisco and other router vendors support SNA.

Cisco, for example, encapsulates SNA Synchronous Data Link Control packets in Internet Protocols before shipping them across a backbone. Cisco is also working with Brixton Systems, Inc. on software that will enable a Cisco router to emulate an SNA PU Type 4 device. This would let it route SNA data without encapsulation and provide more routing options.

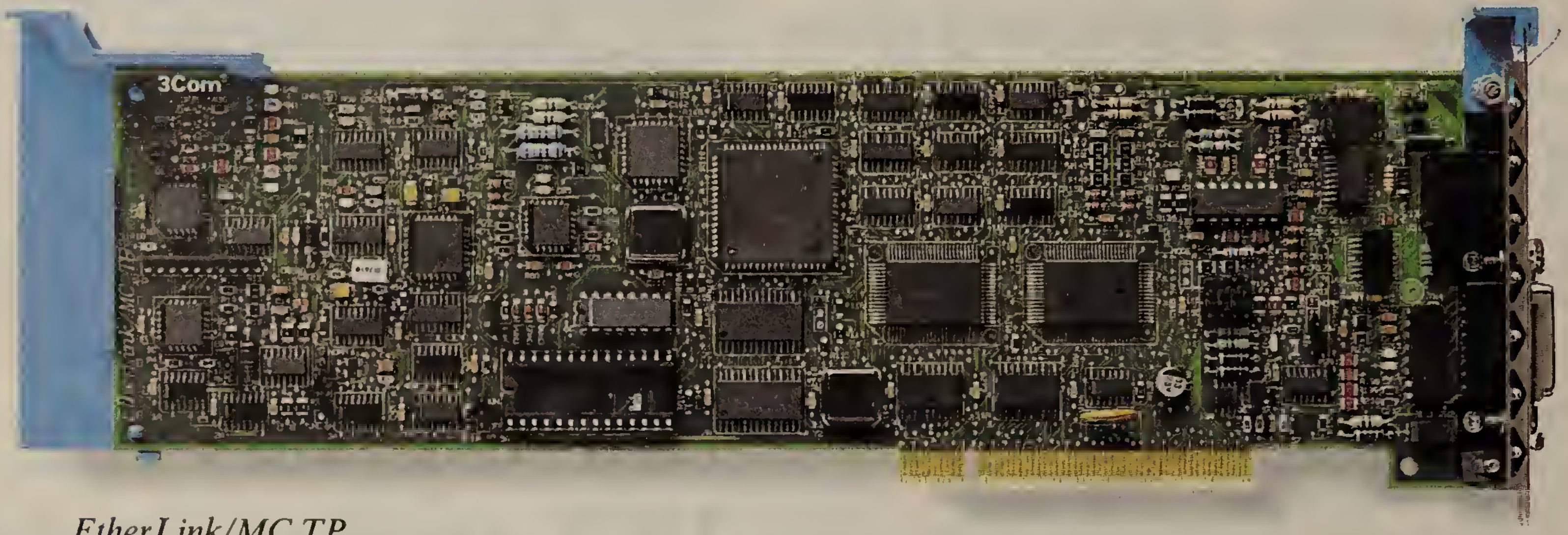
"I am not a supporter of the direction that Cisco has adopted [for supporting SNA]," Warmenhoven said. Reroute times around failed links are not fast enough to keep sessions from being lost when the encapsulation method is used in large SNA nets, he said. And a PU 4 capability, currently deployed on IBM front-end processors, would require complex system configuration and would be too risky to run on a router that is not optimized for redundancy.

Selina Lo

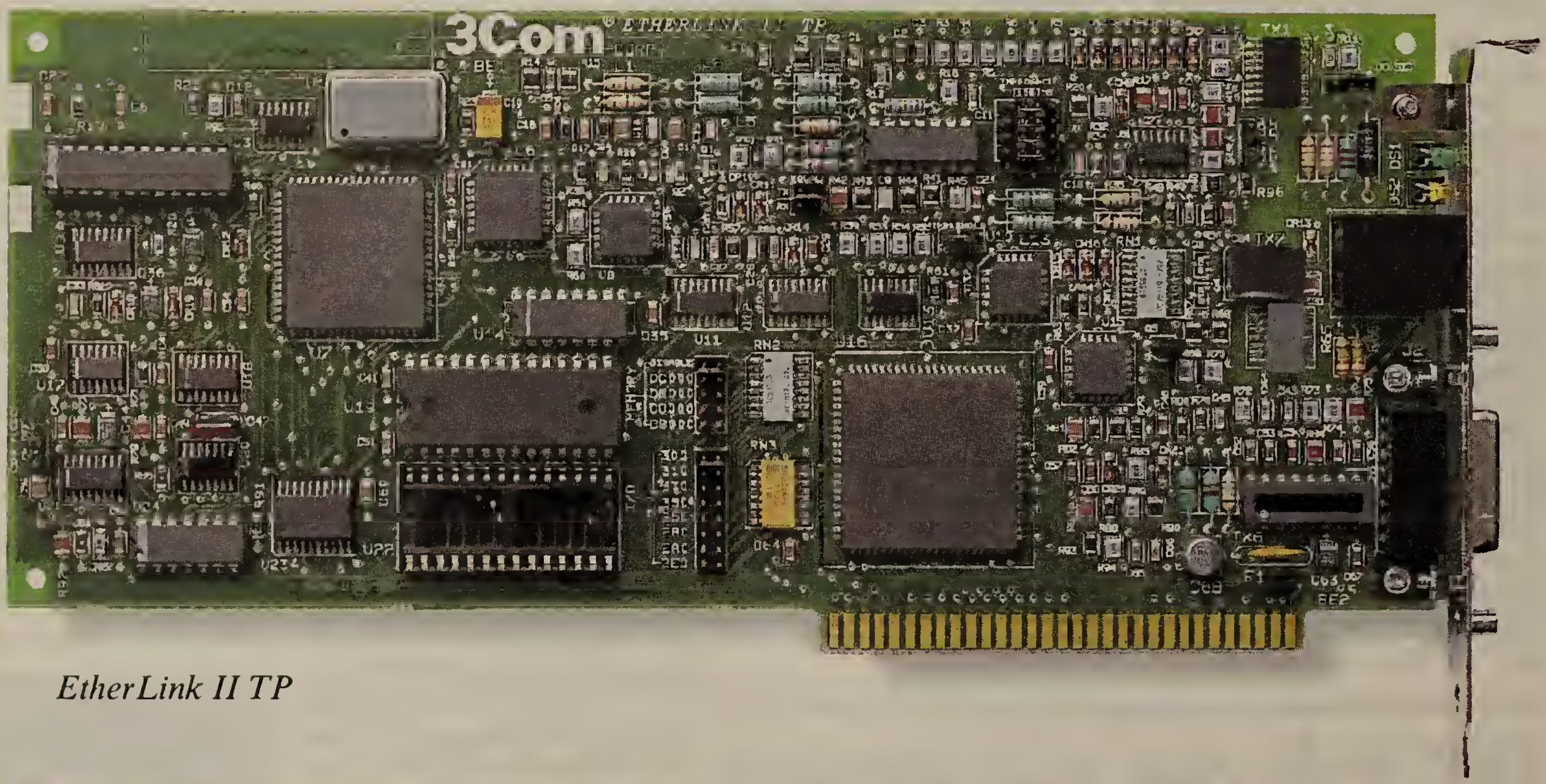
"I would lean much more toward the APPN type of architecture for that kind of solution," he

(continued on page 22)

Every twisted question



EtherLink/MC TP



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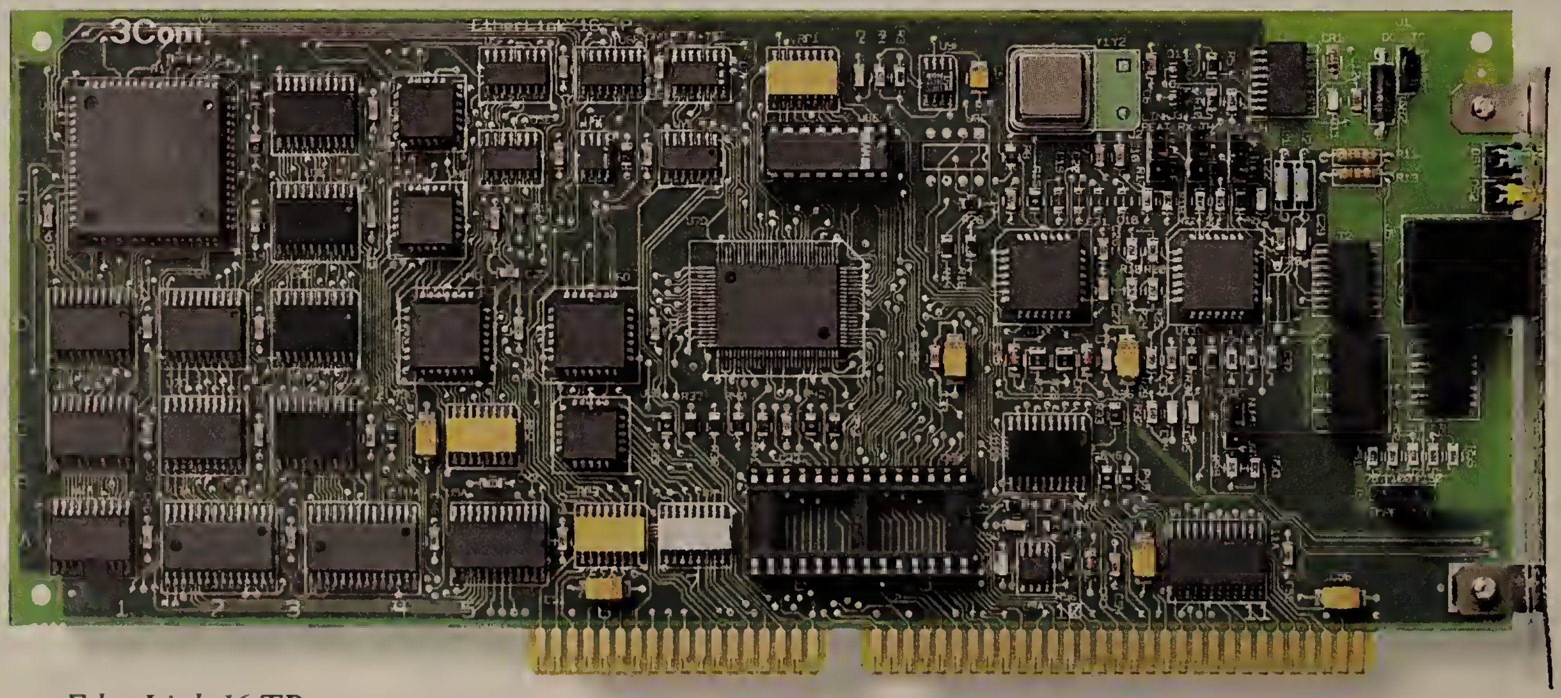

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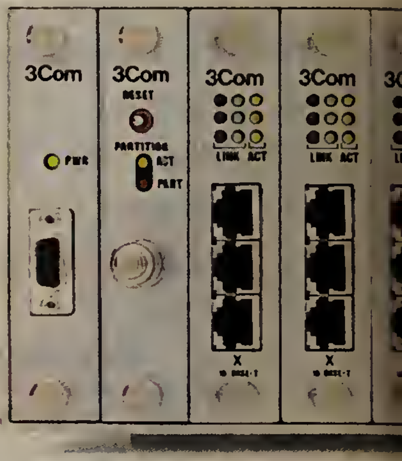

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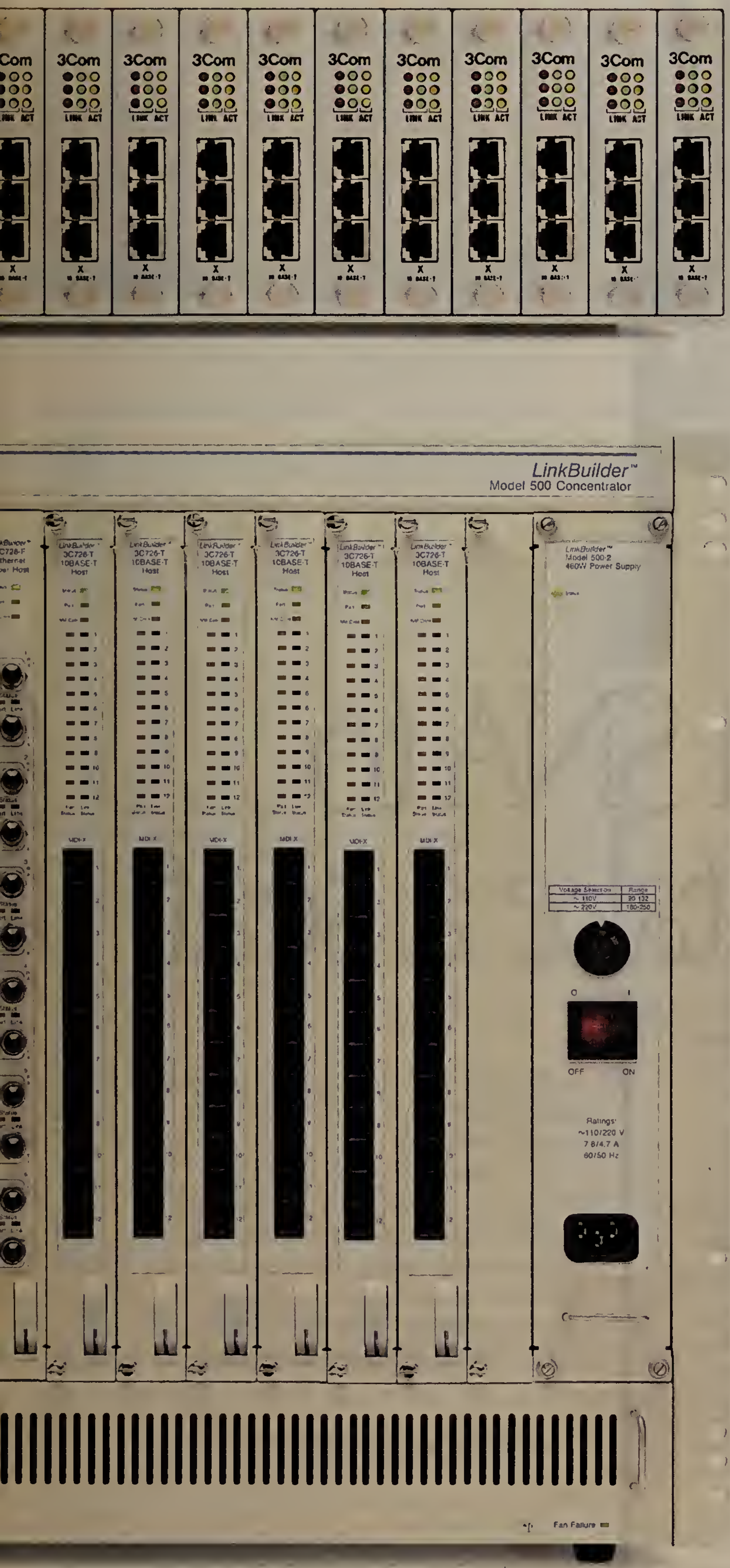
deserves a simple answer.



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July 31	Seattle, WA
Sept 10	New York, NY
Sept 11	Boston, MA
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LOCAL NETWORKING

PC AND TERMINAL-TO-HOST LANS, GATEWAYS AND MICRO COMMUNICATIONS PRODUCTS

Worth Noting

"The difference between [the Open User Recommended Systems] group and other multivendor user groups is that this is more user-centric; others are more like standards bodies."

Mike Bailey
Systems Integrator
Lockheed Corp.
Sunnyvale, Calif.

Netnotes

Amnet, Inc. last week introduced a Novell, Inc. NetWare router for its Nucleus 7000 Series wide-area network packet switch. The Nucleus 7000 Series provides dynamic and adaptive routing, as well as load balancing.

The router is an Ethernet or token-ring add-in module with NetWare routing software. Amnet's Novell LAN router module will be available in September and will cost $2,950.

VisionWare, Ltd., of Leeds, England, has signed an OEM agreement with **FTP Software, Inc.**, of Wakefield, Mass., for FTP's Transmission Control Protocol/Internet Protocol microcomputer software. VisionWare sells microcomputer-to-host integration software including a Microsoft Corp. Windows interface to Unix host systems.

MT. XINU, Inc., a developer of Unix and Macintosh operating system software, last week spun off its Xinet division. As a separate company, Xinet will sell MT. XINU's Apple Computer, Inc. Macintosh-to-Unix connectivity software. The software includes K-A Share 6.0, which allows a Unix system to act as an AppleShare file server and a Network File System gateway for Macintosh computers.

Former MT. XINU President Robert Kridle is now president of Xinet. Deborah Sherrer has assumed the role of president for MT. XINU.

UB will add RISC-based hub modules

By Eric Smalley
Senior Editor

SANTA CLARA, Calif. — Ungermann-Bass, Inc. has announced plans to develop a line of Reduced Instruction Set Computer (RISC)-based bridging and routing modules for the company's Access/One net hub.

One of the paired processors on each card will be used to power a high-performance switched backplane architecture in the hub.

The Enterprise Hub cards will have two Intel Corp. i960 RISC processors — one handling switching, buffer allocation and flow control on the backplane and another handling internetworking tasks such as bridging and routing, according to Jayshree Ullal, director of product marketing at Ungermann-Bass.

The vendor will offer basic internetworking cards for bridging Ethernet, token-ring and Fiber Distributed Data Interface networks. Software upgrades will add routing to the cards as well as support for multiple protocols.

Ungermann-Bass expects to demonstrate its RISC-based Enterprise Hub technology at the INTEROP 91 Conference and Exposition in San Jose, Calif., this October and plans to make products available by year end, according to Ullal.

The RISC processors powering the backplane will be linked via Ungermann-Bass' PlusBus, which consists of existing physical lines in the Access/One hubs. The backplane will operate at up to 320M bit/sec with the bandwidth expanding incrementally as cards are added, Ullal said. The current Access/One hub uses a 10M bit/sec Ethernet backplane.

The switching architecture of the Enterpise Hub eliminates the bottleneck of multiple bridges and routers talking to one pipe, which occurs on Ethernet backplanes where bandwidth is fixed, Ullal said.

Dedicating a RISC processor to each card to manage the backplane allows Ungermann-Bass to distribute key functions, such as flow control and congestion control, to the backplane.

The added horsepower of the RISC processors will also allow network management functions to be embedded on the cards, according to company officials.

In addition to bridge and router cards, Ungermann-Bass plans to offer a concentrator card in the Enterprise Hub series.

Specific product information and pricing have yet to be determined.

Firm unveils peer-to-peer add-on for NetWare LANs

By Caryn Gillooly
Senior Editor

NEW YORK — Artisoft, Inc. recently unveiled a version of its LANtastic peer-to-peer local-area network operating system for Novell, Inc. NetWare LANs at the recent PC Expo show here.

LANtastic for NetWare works in conjunction with NetWare Version 2.15 or higher to enable any personal computer on a NetWare LAN to act as a server and share printers, hard drives, tape backups and applications with client workstations without routing requests through a NetWare server.

"LANtastic for NetWare provides a low-cost, easy-to-use solution to Novell users wanting the features, peripheral sharing and flexibility of a peer-to-peer network," said Jack Schoof, president and chief executive officer of Artisoft, based in Tucson, Ariz.

The net operating system is layered on top of NetWare and uses the Network Basic I/O System. While operational, client workstations remain fully connected to a NetWare server, but they also operate as a work group within that LAN, with separate device and file-sharing capabilities. Within that work group, each client can be either a client or a server in relation to devices within the group.

One benefit of running LANtastic for NetWare is in the area of printing services. Printing has long been a limitation on NetWare LANs, as administrators are hampered to the number of printers that can be attached to the LAN server. With Artisoft's net operating system, however, each machine in the peer-to-peer environment can support as many as five printers.

"With our product, you can put printers anywhere on the network" and put any number of other peripherals on the net as well, a company spokesman said.

The product is expected to be available next month for $499 per NetWare net, with no restriction on the number of nodes supported.

Data base visionary reveals LAN thoughts

Gupta contends data base management systems will be prevalent on LANs sometime after 1995.

Client/server computing, especially as it applies to local-area network-based SQL servers, is emerging as one of the key technologies for building enterprise-wide information systems.

Umang Gupta, president and chief executive officer of GUPTA Technologies, Inc., spoke with *Network World* West Coast Bureau Chief Timothy O'Brien about the factors influencing the evolution of the new data base technology.

Based in Menlo Park, Calif., GUPTA Technologies is a leading software developer offering a family of graphical front-end tools, as well as SQL data base servers and gateways. Last month, GUPTA Technologies announced Quest, a front-end data access, query and reporting tool for use with many leading SQL data bases.

At a recent DB/Expo conference in San Francisco, you said probably only 5% of LANs have data base servers. Considering all the discussions about client/server computing, why do you think user acceptance of SQL in the LAN environment is moving so slowly?

Let me use an analogy. The VAX was announced around 1977. Data base products for the VAX were not generally available until 1981 or 1982, and they really didn't start taking off until 1985. It took 10 years from the advent of the hardware until there was reasonable penetration and proliferation of SQL data bases on that platform.

Today, 70% to 80% of all VAXes have some kind of data base engine on them, mostly an SQL engine. It takes a while to reach the level where most of a platform has been populated with a data base management system.

The way I look at it is the network is the computer of the 1990s. The network provides a means to do computation in a way that has never been done before. Instead of doing computation on a single machine, networks will be used since portions of the applications can run on a personal computer, another portion on a server and another portion on a mainframe.

So the question then becomes, when will 80% of the world's networks have a data base management system? My personal opinion is that it could be probably as early as five years from today, in 1995. It could be as late as the end of this decade.

We are talking of long cycles. Why does it take that long? Because inherently data base management systems require somebody to program and develop them in a way that is organized into forms, rows and columns.

It involves more effort in the setting up of data for the application's usage than a product like a spreadsheet or word processor, which is basically a stand-alone personal productivity program.

Umang Gupta

In this 10-year or five-year cycle, depending on whether you are a pessimist or an optimist, we are still in the first or second year. Users of our LAN-based server data bases are very early in the technology cycle.

There are probably 15,000 to 20,000 data base servers out there today. But there are probably half a million LANs capable of running data base servers — a 3% to 4% penetration. Next year, we might have 8% or 10% penetration. In 1992, it might grow to 15% or 20%; the next year might be 25%.

However, the numbers we are talking about for potential data base servers are incredibly huge when you consider there are about a million LANs today, and in five years, we may have five million LANs. If 80% of these LANs were to have a data base server, you are talking about four million data base servers. If the average price for a data base server is at least $1,000, this will be

(continued on page 18)

Visionary reveals LAN thoughts

continued from page 17

a $4 billion market in data base servers alone.

Then, consider that there will be about 100 million personal computers connected to these LANs. If many of them had a front-end query tool, like our Quest, selling for an average price of $500, you are talking about another few billion dollars. These are huge numbers. But it will take a while to get there.

What are the biggest challenges in getting there?

There are three, but let's start with the one everybody talks about: the idea that data base servers are going to take off when there are tools available. Clearly, tools are one prerequisite. But they are not enough.

The whole notion of SQL has taken data base management further along because, in effect, you don't request an entire file to select out the records you want. With SQL, you end up just issuing an SQL statement that gets you only the rules of data you want.

So there is more performance, and the integrity of the data is better. However, achieving that required programming. Tools will change that because people will be able to start taking advantage of these data bases without doing programming. But even if you have all the tools in the world, there are some other conditions that must be met in order to have client/server technology truly succeed. One of those is the refinement of networking technology.

I don't see client/server being limited to data base servers.

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How often does a network go down today? I don't know the exact numbers, but I know one thing: it goes down more often than a minicomputer or a mainframe does. You are not going to run your critical applications on a LAN if you believe it might go down once every other day.

And today, all you do is move data back and forth. What happens when you want to start moving video or other graphical media? You need more bandwidth. It's one thing to have a network comprised of LANs internetworked in a single location, but not all corporations work that way. General Motors [Corp.] has 200 plants and offices all over, even in Brazil.

Today, I can download or upload software from a LAN to a mainframe at maybe 56K bit/sec, which is the most common lease line I can get. But 56K bit/sec is not enough for some cooperative processing applications. What might be required is 2M or 4M bit/sec. So a second condition necessary to make client/server technology really explode is the network — its bandwidth, its reliability and its robustness.

The third requirement to make client/server technology truly explode is more education. Most people are used to writing applications in C, COBOL or even dBASE. Well, not all programmers have learned how to write applications under a graphical user interface like [Microsoft Corp.'s] Windows instead of the old character-based systems. That requires ongoing education for the value-added resellers and the consultants.

It will be an evolutionary process. Every year, we do better than we did last year.

The notion of client/server seems to have evolved from the file server and has been successfully applied to data base servers. Now the client/server concept is being extended beyond data base servers to other areas, such as electronic mail, communications and other applications. Do you see the concept of front-end tools working with standards-based back ends in these areas?

Let me start by pointing out you are absolutely right that an SQL data base server was an intuitive thing. After you think of a file server, you ought to think of a data base server. It's reasonable.

In fact, there are already communications servers. Mail servers are reasonably intuitive in the sense that it is still simply a data base serving messages. But in time, there will be many other servers of this kind. And I don't see client/server being limited to data base servers.

I think of many other servers that people haven't thought about today. There could be an application server that does meteorological calculations on a special machine. Or there could be a floating point process server.

So there will be many servers, but for every server, there must be an an application program interface (API) that is on some front end to take advantage of this server.

Do you think the market will evolve in a way that there is going to be a proliferation of front ends that work with each of the different back-end servers? Or will a leading front end that works with many servers emerge and become the standard?

First of all, in the war among graphical user interface-based tools, less is more. Instead of having one front end that does too many things, the more likely scenario is a front end that is very user-specific and task-specific.

Personal computer products like dBASE and Lotus [Development Corp.'s] 1-2-3 try to add as much functionality as possible because you can't run anything else at the same time. So to get the maximum bang for the buck, a user needs to use a graphical environment like Windows.

The key transition will be to tools that work around a common user interface. There shouldn't need to be a lot of new learning with every different tool, and data should be able to automatically shift from the SQL Server to the different applications.

However, there will be a proliferation of many tools and there will be more tools that address specific markets. The challenge will be in making these tools work with each other. And standards are just beginning to occur. It's one thing to have a user interface standard everybody follows. But nobody has yet demonstrated that people will be able to build these tools that will converse with each other.

What does it mean to get a row of data or a set of rules of data from a personal computer and then make a graph out of them? A graph out of a row or a column of information?

This semantic information has got to be transported back and forth, and that requires standards of communicating between application tools. Over time, there will be other standards with object-oriented metaphors and the ability for one object to send messages to the other. So you will eventually have a lot of tools from different people working closely with each other.

The key to success in this business for a vendor is following the standards of the user interface that are being set and we are following the Windows standard and the [IBM] Presentation Manager standard.

When you mentioned network reliability as being one of the requirements for SQL to succeed in the LAN environment, what about the role of the network operating system? Are the issues of enterprisewide networking holding back the implementation of successful client/server applications?

As much as we would love to have it, it is not likely to occur in my lifetime — that there is going to be one standard for communication between front ends and back ends on a network. In most Unix networks, it seems to me that TCP/IP is the standard of choice today. The OSI model is still a long-term direction.

In the PC LAN world, at least, NETBIOS seems to have become a ubiquitous enough standard but it suffers from inadequate naming and interoperability schemes.

Novell is clearly interested in SPX, IPX and all of the naming facilities that go with these protocols. Microsoft would like to push Named Pipes and Banyan [Systems, Inc.] would like to push StreetTalk. IBM, in fact, would like to go with APPC as a mechanism for interconnecting different standards, so I don't see any of them going away.

In the war among graphical user interface-based tools, less is more.

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Frankly, out of all of these the strongest ones are clearly the Novell, IBM and Unix standards. In the worst case, you are at least talking about three different standards or possibly a couple more.

The key in the short term is going to be for application developers to build products that work with multiple standards, and that's going to mean more gateways, routers and bridges.

What about the tension between market leaders and committees trying to set standards? Don't you need to accommodate both?

Best way that I can think about it is AT&T and how they built the telephone business vs. where we are today. The reason I think we ended up with one standard in the telephone business in America is because AT&T was granted a monopoly by the government.

In return for the monopoly, AT&T brought order to the communications business. Having just one standard, everything worked a certain way. We are going back out of that monopoly today into more competition but by now all the standards are set, so it's hard for any company like MCI or US Sprint to suddenly come along and set new standards.

As the new technologies proliferate, there are certain issues that concern how these various companies communicate with each other. They use switches, routers and bridges. However, the end user doesn't see these things; they all occur at the back end.

The problem is we don't have a natural monopoly in the computer communications business. And it doesn't seem, in the near future, that there is going to be a natural monopoly. And I suspect that we are going to be in the current mode of competition for a long time.

With Quest, you are addressing the end-user market instead of developers for the first time. Are you slowly changing your focus to the end user?

From a pure revenue source, the shift is clearly going to be more and more client software. If you look at our revenue from three years ago, 100% came from data base servers and nothing came from the front ends.

Today, 50% of our business comes from front-end tools and the other 50% comes from data base servers and connectivity software. In time, I believe that perhaps as much as 75% of our business will come from the tool business and the other 25% will come from the servers and connectivity.

You can't get away from the servers and connectivity because they are essentially the enabling technology to help you sell the tools. They are the razors that sell the blades. But there is a lot more money in the blades.

How will you deal with supporting the end user since you have worked only with developers to this point?

One of the things we started within our company was the idea that support must be paid for by the customer. In other words, we do not bundle support with our products. I don't think any company in the 1990s is going to be profitable bundling support with products. Everybody charges for support now. So we are going to charge for support for Quest.

I often tell people that the single most important determinant of the success of our business is how effectively we can provide mainframe-class support to personal computer-class customers.

How big is GUPTA Technologies?

We have 140 people. We are privately held, but I will say that we are looking to do about $20 million. We have been growing at an average rate of between 80% and 100% over the last six years. If we continue to grow at the same rate over the next three years, we should be a $100 million company in the 1993-1994 time frame. ◘

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MANAGEMENT STRATEGIES

MANAGING PEOPLE AND TECHNOLOGY: USER GROUPS AND ASSOCIATIONS

Worth Noting

"Though it's more expensive to implement in the short term, there's no question that a client/server environment is the best way to put information in the hands of the end users that really need it."

Michael Kaminski
Manager of computer-integrated management/networking technologies
General Motors Corp.

Association Watch

EDI experts from the broadcasting, health care, insurance and manufacturing industries will speak at the 23rd Annual EDI Users Conference and Exhibit, sponsored by the **Electronic Data Interchange Association (EDIA)**, to be held Dec. 10-12 at the San Diego Marriott Hotel and Marina.

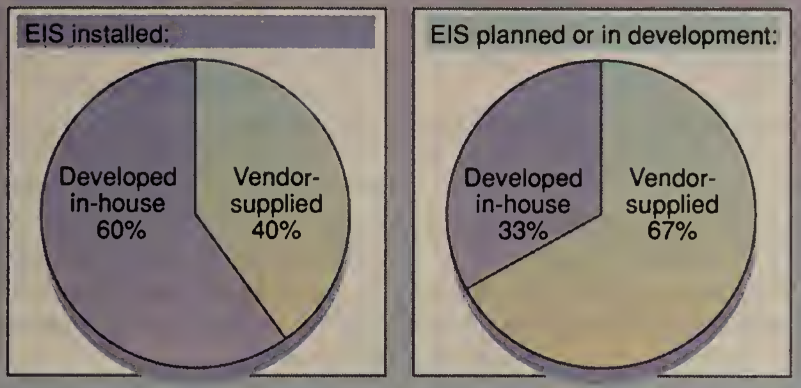
Speakers will discuss the use of EDI in their vertical markets. James Connelly of Baxter International, Inc. will explain how his company is using EDI to curb rising health care costs, while John Lowenberg of Aetna Information Technology will discuss how EDI is used in the insurance industry to significantly reduce paperwork and processing.

The conference costs $550 for EDIA members and $650 for nonmembers. There is a $100 additional charge for those attending two half-day tutorials prior to the conference. For more information, contact EDIA at (703) 838-8042.

In related news, Jerome Dreyer recently resigned his post as president of EDIA — a position he has held for the past three years. Dreyer is leaving to focus on an independent writing and consulting career but will act as interim president until EDIA elects a new president. ◘

Shift in the EIS build vs. buy decision

Origin of EIS at user companies



Users are moving away from homegrown EIS and relying more on vendor-supplied packages, according to figures based on 1989 survey of 300 senior information systems managers.

EIS = Executive information systems

GRAPHIC BY SUSAN J. CHAMPENY SOURCE: INTERNATIONAL DATA CORP., FRAMINGHAM, MASS.

Users look outside for help on executive info systems

A growing number turn to packaged EIS products.

By Wayne Eckerson
Senior Editor

Users are increasingly turning to vendor packages for executive information systems (EIS), rather than building systems in-house from scratch (see graphic, this page).

EIS typically gives top corporate executives a wealth of information on key business variables from data bases throughout the company. They also provide electronic mail, graphics and some decision support capabilities as well as access to external news retrieval sources.

By employing vendor-supplied EIS software that is available across all platforms, from personal computers and local-area networks to mainframes, users can minimize the time and expense required to deploy these valuable management applications.

"Five years ago, people built EIS in-house, but now they realize they can implement a robust, fully featured system much more quickly using vendor software," said Eileen Carlson, an independent EIS consultant in Chicago.

Although using commercially available EIS software eliminates much of the hassle involved in implementing an EIS, users must still resolve some thorny technical issues before deploying a fully functional system.

Primarily, users must reconcile the different reporting and data formats used throughout a company and decide whether to feed information directly into the EIS or pool it in a centralized repository that executives can access.

Just five years ago, vendor EIS software alone could cost users $200,000. Add hardware, programming and consulting costs to that, and the initial investment in EIS could be staggering. With the advent of personal computer-based IS, such as Pilot Executive Software's Lightship product, users can get started for as little as $10,000, Carlson said.

Users are also attracted to commercial EIS because it spares them from constantly redesigning an in-house system to keep pace with technological advances and new computing and network standards.

But vendors cannot solve all user problems.

Users often run into difficulties when compiling data requested by executives because they frequently discover that company departments or divisions have no uniform way of collecting this data. This lack of coordination makes it nearly impossible to present executives with reliable information.

Departments collect different types of data and use different formats to present it. Moreover, the way departments define terms such as sales revenue and calculate figures based on those terms may differ. Sometimes it can take years for companies to sort out the confusion.

Samaritan Health Services in Phoenix, for example, spent months trying to reconcile its basic financial data before it could give executives the information they wanted, according to Charles Emery Jr., vice-president of IS at Samaritan.

In some cases, the data was based on managerial accounting principles, the kind used by managers to produce annual budgets. Other data was based on financial accounting principles, which are used to calculate income statements for annual reports.

Besides reconciling data, users must decide whether they

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Downsizing to LANs not easy, users say

Pioneers say financial factors, internal resistance and lack of technical knowledge are deterrents.

By Maureen Molloy
Staff Writer

NEW YORK — Despite the promise of low overhead, cost savings and improved services, few users have downsized mainframe applications to local-area networks because the deterrents often outnumber the benefits, according to several users.

Speaking at the recent Downsizing in the Computer Industry Conference here, a handful of users and consultants that have worked on downsizing efforts said the greatest obstacles to implementing a distributed computing platform include an expensive and complex implementation process, resistance from both end users and internal MIS personnel, and insufficient technical tools and expertise.

"Downsizing is a paradigm shift where intensive management and technological issues need to be addressed and resolved," said Cheryl Currid, president of Currid & Co., a Houston-based consultancy.

As former director of Applied Information Technology at Coca-Cola Foods, Currid designed and implemented a LAN-based enterprisewide network that connected virtually all the desktop computers in that company. "It's a difficult transition, no question," she said. "But it is the prudent decision for many organizations because distributed computing is the platform of the future."

Many users attracted by the promised benefits of downsizing say they will nevertheless remain in the information gathering stage and not proceed further until the process becomes more manageable. Like many network and MIS managers attending the recent downsizing conference, most are eager to learn how other users overcame setbacks to forge ahead with a successful downsizing project.

During the conference, net managers from six large U.S. firms — Dunkin' Donuts, Inc., E.I. du Pont de Nemours & Co., Pacific Gas & Electric Co., Pennsylvania Blue Shield, Sara Lee

(continued on page 22)

EXECUTIVE BRIEFS

BY WAYNE ECKERSON

Contest calls for tools helping the disabled. The Johns Hopkins National Search will be giving out a $10,000 grand prize and more than 100 other awards to people who devise innovative ways for using computer technology to assist disabled people. The deadline for submissions is Aug. 23.

There will be three categories of entries: computer-based hardware devices, software programs and written ideas. The inventions should be geared toward helping individuals who are sight- or hearing-impaired, learning disabled or mentally retarded. Inventions can also assist people who have difficulty with language and communication, neuromuscular or neurological disorders, or limited mobility.

Applications can be obtained by writing to Computing To Assist Persons With Disabilities, Johns Hopkins National Search, Johns Hopkins University, P.O. Box 1200, Laurel, Md. 20723-6099.

Firm offers evaluation of technology. The Generics Group, Inc., a worldwide management consulting firm, says most companies fail to leverage the full value of technologies or assets they have developed in-house through research and development. Generics will evaluate the commercial potential of technology, applications or intellectual property that may no longer be pertinent to the firm's core business.

The company also provides financial and marketing analysis as well as technical assistance to complete necessary development work on unfinished or suspended programs.

For more information, call (617) 290-0500.

Downsizing to LANs not easy

continued from page 21

Corp. and the United Parcel Service of America, Inc. (UPS) — discussed their experiences in spearheading companywide downsizing efforts.

Each network manager experienced the promised benefits but not before overcoming some initial opposition from corporate end users, internal MIS personnel or both. Many employees feared the loss of their jobs, loss of power or control, and a perceived burden of added responsibilities, they said.

"A distributed environment reduces overhead by automating redundant tasks, so the jobs of some employees will be in jeopardy. But in most instances, it's a matter of increasing the productivity of employees rather than eliminating positions," said Paul Evans, vice-president of MIS at Design Foods, a division of Sara Lee.

Many end users also believed that administrative tasks such as file backup and loading applications are the responsibility of the MIS organization.

"The best way to quell fears is to show users how bringing more power to the desktop will help them perform their jobs more efficiently and effectively," he added. "If they don't understand that, they'll only feel that MIS is passing off their work load to the customer."

Most net managers also encountered resistance from internal MIS personnel. This often stems from MIS staffers who fear downsizing and the loss of centralized control will deflate the importance of their department within the organization.

"Many traditional MIS people are leery of putting mission-critical applications in the hands of users," said David Bennett, MIS director at Dunkin' Donuts. "They believe that applications shouldn't be processed on anything but a mainframe."

Users said a distributed platform does not diminish the role of MIS but, in fact, allows the department to achieve greater respect and visibility within the organization. This occurs because, in an enterprisewide network, the technology is the organization's infrastructure and largely governs the company's functional effectiveness.

Michael Kinsey

Not every user will be swayed, however, and all warned that a downsizing effort will initially result in a significant employee exodus. The average attrition rate during the initial stages of downsizing at the six companies profiled hovered near 50%.

"Expect to lose people because downsizing is a significant cultural change. It changes — and improves — the way people do business, but many will be uncomfortable with the change and refuse to adapt," said James White, principal downsizing consultant at Du Pont Information Systems.

Marc Dodge, manager of the Corporate LAN Support Group at UPS, agreed.

"Many current skills won't fit into the new architecture, so retraining soon becomes one of the biggest issues in downsizing," he said. "You will have employees who can't, or won't, learn new skills."

But despite the headaches, all said downsizing is well worth the effort. The best way to smooth the transition is to aggressively promote the idea before actual implementation. "Sell, sell, sell is the best advice I can give," said Michael Kinsey, manager of Network Planning & Design at Pennsylvania Blue Shield. "The [information systems] mission must be to promote the value of downsizing to every person in the organization."

Arthur Beckman, manager of Information Technology Services at Pacific Gas spends an average of three days a week selling the idea of what he calls "the empowered user" to every department throughout the company.

"Everyone in the organization is affected by downsizing, so everyone must accept it in order for it to succeed," he said. "After a while, selling will become the biggest element of the network manager's job."

Users look outside for help

continued from page 21

want to download data directly from various transactional data bases into the EIS or pull data from an extracted data base or data repository. The strategies used often depend on how much analysis executives want along with the data.

Some detail-oriented executives want to examine raw, operational data and draw their own conclusions. In this case, users can build hooks into departmental data bases to extract transactional data.

Most executives, however, prefer that middle managers or analysts examine the data for trends and unusual variances and recommend possible actions. In this case, users have to feed text and summary data into the EIS.

Carlson recommends that users build a central repository for storing operational data. This repository can be a decision support system or management reporting system that runs on either a mainframe or local file server.

In either case, managers or analysts can perform various calculations or run analytical models against the data in the repository using spreadsheets and other tools. The results, which can be annotated with comments, can then be uploaded to the EIS, which presents the data in a user-friendly format.

Departmental managers at Inland Steel Co., for example, use Lotus Development Corp.'s 1-2-3 spreadsheets to analyze operational data kept on the company's mainframe. The managers create electronic reports that contain spreadsheet data, as well as notes, commentary and recommended actions. The reports, which come out daily, weekly, monthly and quarterly, are then fed into the firm's EIS.

Although the process involves a lot of manual intervention, it gives executives the information they want, said Kevin Green, project manager of EIS at Inland Steel in Chicago. It also offers flexibility in case the business climate or the needs and interests of the executives change.

"We are packaging data according to a mental model executives have," he said. "That requires adding human value."

NET explains role of LWX

continued from page 13

said. "And I am hopeful that our relationship with IBM will allow us to implement a solution to that set of requirements."

NET would need to implement the APPN network node specification, as opposed to the end node specification, in order to give the IDNX SNA routing capabilities, he said. IBM has not yet decided if it will license that specification but said it is considering doing so.

Even with APPN support, the LWX is not expected to displace high-performance routers used to link multiple LANs in a building or campus environment. "I see [the LWX] as very complementary to that class of router," Warmenhoven said.

The LWX is more appropriate for wide-area networking than stand-alone routers because it can take advantage of the redundancy features built into the IDNX. They include redundant power supplies, CPUs and other hardware components, plus the ability to route around a failed link in milliseconds. "Most of the routers today are nonredundant. Their architecture cannot be fitted to support redundancy," said Selina Lo, internetworking product line manager at NET.

Because the LWX does, or will, support most LAN and internetwork routing protocols, it will work with other stand-alone routers. "We've even tested in-house its IP routing compatibility with Wellfleet [Communications, Inc.] and 3Com [Corp.] routers," she said.

Future enhancements will enable the LWX to support the ISDN Q.931 signaling protocol. Some carriers are pushing Q.931 as the standard required to access such high-speed services as switched T-1 or broadband ISDN.

NET's Warmenhoven also said the IDNX's new packet capability offers advantages over the proprietary fast packet architecture used by StrataCom, Inc. in its IPX multiplexers.

StrataCom divides all voice and data into 24-byte cells, each with a header of three to four bytes. By contrast, the IDNX allocates circuit-switched bandwidth to voice and other synchronous data applications. Applications such as LAN traffic can use the new packet module, which accepts data packets of any size, thus avoiding the added overhead of dividing packets into 24-byte cells, each with its own header.

"You can fit more voice calls on an IDNX trunk than you can on a StrataCom trunk because the packetization adds overhead," Warmenhoven said.

Charles Corbalis, director of system architecture and data communications at StrataCom, said it's true StrataCom packetizes all data and voice in 24-byte cells, which he acknowledged is a downside of its cell-switching architecture.

"On the positive side, you can mix lots of different sources together — video, voice, data — onto the same transmission facility, using the same switching technology," he said. That enables the IPX to take advantage of the statistical probabilities regarding how often each type of traffic will fully utilize its allotted bandwidth.

The IDNX can do that only on a more static basis, such as changing bandwidth allotments by the time of day.

MCI melds nets with unit

continued from page 9

neric software on the switches in MCI's switching centers to serve both MCI and Telecom*USA customers.

"It's a tricky process because we had to design the software so there was no mutual exclusivity; that is, so that it would not only continue to support the MCI products, but would likewise be able to support Telecom*USA services," such as personal 800 numbers, Sheldon said.

By year end, MCI plans to have upgraded the generic, or base functionality, software on all of its Northern Telecom, Inc. and DSC Communications Corp. switches, Sheldon said. The Telecom*USA switches, most of which were made by DSC, will not be upgraded because Telecom*USA's switching offices are being phased out as traffic is migrated off its network.

For now, MCI has installed tens of thousands of trunks to link Telecom*USA switching offices to MCI's existing switching offices so traffic can flow freely between the two nets, he said.

"This merger is being done the right way," he said. "A lot of work has gone into the development of software capabilities within MCI switches and back office systems so that the Telecom*USA customer base could continue to receive the services that it has always had and so the MCI customer base would also have access to those types of features."

The easiest part of the entire network integration process was persuading MCI's top executives to merge the net in an evolutionary manner, Sheldon added.

"MCI's senior officers were easily convinced that they should not take a parochial view that MCI's way is better than Telecom*USA's way," he said. "Telecom*USA was about as unique a company as there was in the telephone industry."

AT&T plans to start PCN trials

continued from page 11

gin. Phase 3, scheduled to last 12 months, will be a full technical trial with a total of 1,000 users in the three cities.

AT&T said the three test cities will be tied together over AT&T's long-distance network. AT&T will test handsets that can handle both inbound and outbound communications to and from home, office, street and automobiles. The PCN handsets will also be connected to the public network so that users can place or receive calls from non-PCN users.

AT&T said it will test four major PCN features: call screening, which allows only calls from designated numbers to be delivered; schedule-driven delivery, which directs the network to deliver calls to different phones at various times of the day; call waiting; and call redirect, which allows a user to direct incoming calls to a voice messaging service.

INTERNATIONAL NETWORKS

USER STRATEGIES, INTERNATIONAL SERVICES & REGULATION

World News

AT&T recently asked Congress to rescind laws prohibiting provision of long-distance service to Vietnam.

Dwight Jasmann, AT&T managing director for network services in the Pacific Rim, said Cambodia, North Korea and Vietnam are the only countries U.S. carriers cannot serve.

Jasmann told the Economic Policy and Trade subcommittees of the House Foreign Affairs Committee that the restriction is unfair to consumers because resellers bypass the restriction by routing calls through countries that do not ban service to Vietnam. These companies charge as much as $80 for a 10-minute call.

Observers are optimistic that a consortium of companies lead by **Cable & Wireless PLC** will soon receive approval from the Co-ordinating Committee on Multilateral Export Controls, a Paris-based organization responsible for policing high-technology exports, to build two fiber-optic cables serving the Soviet Union.

Cable & Wireless, in conjunction with Simplex Wire & Cable Co. and the Soviet Ministry of Post and Telecommunications, has proposed building fiber cables running from Stockholm, Sweden, to Leningrad, and from Nakhodka in the Soviet Union to South Korea. Both cables would be linked to a global fiber network. Cable & Wireless estimates the systems would cost between $100 million and $150 million. ◪

Global virtual net face-off: AT&T vs. US Sprint

Carrier Service	Country served	Peak period	Peak period usage charge	
			First 30 seconds	Additional 6 seconds
AT&T				
Global Software-Defined Network	Australia	2 p.m. to 8 p.m.	$.775	$.0625
	Canada	8 a.m. to 6 p.m.	.19	.029
	France	7 a.m. to 1 p.m.	.5714	.0689
	Japan	2 p.m. to 8 p.m.	.99	.0868
	U.K.	9 a.m. to 1 p.m.	.32	.23
US Sprint Communications Co.*				
Global Virtual Private Network	Hong Kong	7 a.m. to 1 p.m.	$2.17	$.09
	U.K.	7 a.m. to 1 p.m.	.32	.064
Country Virtual Private Network	Canada	8 a.m. to 6 p.m.	$.19	$.029

*Pricing for on-net to on-net service only.

SOURCE: AT&T, MORRISTOWN, N.J., CABLE & WIRELESS PLC, LONDON, AND US SPRINT, WASHINGTON, D.C.

GRAPHIC BY SUSAN J. CHAMPENY

Comparing the Big Three's global virtual net services

Examining the reach, pricing and features of each.

By Barton Crockett
Senior Editor

After more than two years of marketing hype, international virtual network services from the three leading U.S. carriers have finally evolved to the point where serious comparison shopping is possible.

Combined, AT&T, MCI Communications Corp. and US Sprint Communications Co. now offer international virtual net services to a total of six countries (see graphic, this page). Service to most of these countries only became available within the past two months.

"Global virtual nets have finally become a real product, instead of a lot of hype," said Daniel Briere, president of network consultancy TeleChoice, Inc. in Montclair, N.J.

Currently, the Big Three's international virtual network usage charges are almost identical. The offerings are distinguished primarily by the number of countries served and the features supported.

AT&T has an early edge in the number of countries supported, with a total of five to date. US Sprint now serves three countries, while MCI only offers international virtual net service to one country.

AT&T offers Global Software-Defined Network (SDN) service to Australia, Canada, France, Japan with Kokusai Denshin Denwa, Ltd. (KDD), and to the U.K. with British Telecommunications PLC.

This month, AT&T plans to expand Global SDN service to Mer-

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Videoconferencing is focus of ITCA show

Int'l association discusses experiences with video meetings, transport options and carrier privatization.

By Ellen Messmer
Washington Correspondent

WASHINGTON, D.C. — User experiences, transport options and carrier competition were among the subjects discussed at the recent International Teleconferencing Association (ITCA) conference here.

One of the highlights of the conference was a three-way videoconference among London, Paris and Washington, D.C., which was used to bring together a panel of users and regulatory officials to exchange views on international videoconferencing.

During that session, Doug Roberton, manager of technical and installations planning for Ford of Europe, Inc., announced from London that Ford Motor Co. has added three new videoconferencing rooms to its worldwide network, expanding its international facilities to 35 rooms.

"Videoconferencing has become integral to our existence," Roberton said. "The benefits are clearly speed and quality of decision making." Ford has used videoconferencing since 1984.

But both Roberton and another user on the ITCA panel, Carol Johnson, international information technology manager at ICI Americas, Inc., complained about the high cost for international videoconferencing.

Johnson said ICI Americas began using international videoconferencing about a year and a half ago. The benefits were undeniable, she said, but "the costs are still rather high."

Users also run into unexpected costs. In the U.S., for example, a 384K bit/sec videoconferencing link can be used to access a link to Germany, but in Germany, customers must use a T-1 access pipe. Roberton said he had spoken a few months ago to Deutsche Bundespost Telekom officials about the situation. "They were still debating what to do."

According to Nicholas Houery, chairman of the European Videoconferencing Service, a Conference Europeenne des Postes et Telecommunications (CEPT) technical group, the effectiveness of new low-speed coder/decoders has fueled interest in 64K bit/sec Integrated Services Digital Network as a transmission option. Much of Europe now has ISDN in place. But Houery pointed out that European PTTs have traditionally subsidized their higher bandwidth services to encourage videoconferencing and that this subsidy may have lessened the attractiveness of ISDN.

"In France, in particular, there is a certain level of [subsidization of] higher bandwidth services — such as E-1 — that could take away from the attractiveness of ISDN," he said.

But Houery added that the situation is likely to change since France Telecom was made independent of the government last January. "Next year, France Telecom will probably stop subsidizing E-1," he predicted.

Other European officials on the ITCA panel said they also expect the privatization of several European PTTs and the European Community's efforts to build a common market by 1992 will create more competition and result in lower cost transmission facilities for videoconferencing. ◪

What it takes to be the international specialist. **#4 in a series.**

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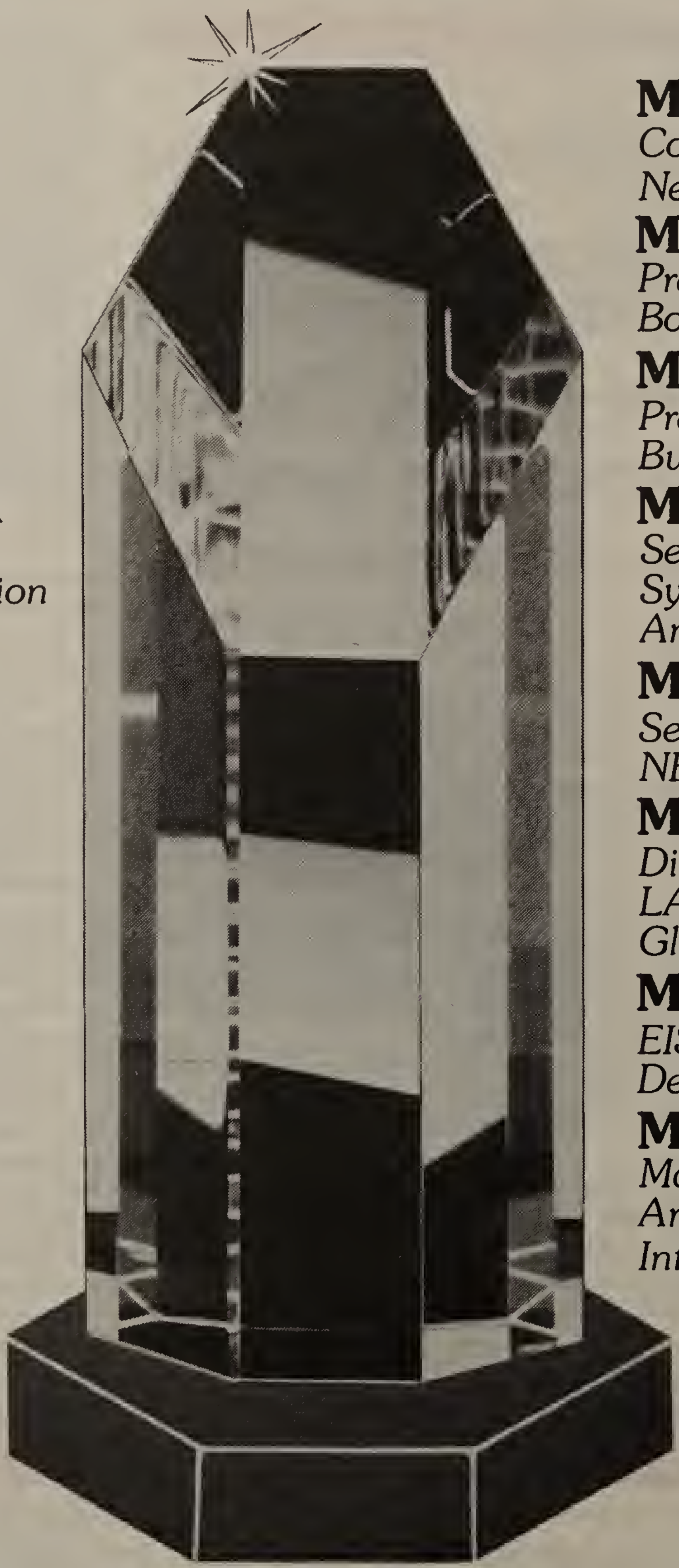

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omparing lobal services

ntinued from page 23

cy Communications, Ltd. in the K. Global SDN service to Norway and Italy is scheduled to nmence within a few weeks, ile service to Belgium, the therlands and Spain is scheded to begin in the third quarter. early 1992, AT&T plans to offr Global SDN in conjunction th at least 15 foreign carriers.

Today, the carrier's Global N service is a bare-bones offerg. It enables users to integrate foreign offices into the same customized, seven-digit dialing plans serving domestic SDN sites. It also offers much faster call setup times than AT&T's International Direct Dial service, as well as discounts of 20% to 30% off standard international calling rates.

Andrew Burroughs

AT&T is taking a bilateral approach to the deployment of Global SDN by integrating the service with the virtual net services offered by foreign carriers. The foreign services support different feature sets than Global SDN.

According to William Evans, AT&T's Global SDN product marketing manager, the carrier's reach gives it an edge in the market. "We're going to the countries users do business in," he said.

According to Evans, half of AT&T's domestic SDN users have significant international traffic, and the majority of these users are interested in subscribing to Global SDN. But he declined to say how many Global SDN users AT&T currently has.

Multilateral edge

Even though it doesn't have the widest reach, US Sprint has an edge over rivals with its multilateral approach to international virtual network services, according to Andrew Burroughs, US Sprint's vice-president for global marketing.

The multilateral approach means that each carrier supporting US Sprint's Global Virtual Private Network supports those features on the same Northern Telecom, Inc. central office switch platform.

US Sprint actually has two international virtual net services. The multilateral GVPN supports a range of advanced calling services as well as switched 56K and 64K bit/sec transmissions. US Sprint also offers a scaled-down bilateral service, called Country VPN, which basically supports the same features that AT&T supports with Global SDN.

Burroughs claims that the multilateral approach enables US Sprint to roll out more advanced services and features than AT&T supports. For example, AT&T does not support switched 56K or 64K bit/sec service as part of Global SDN.

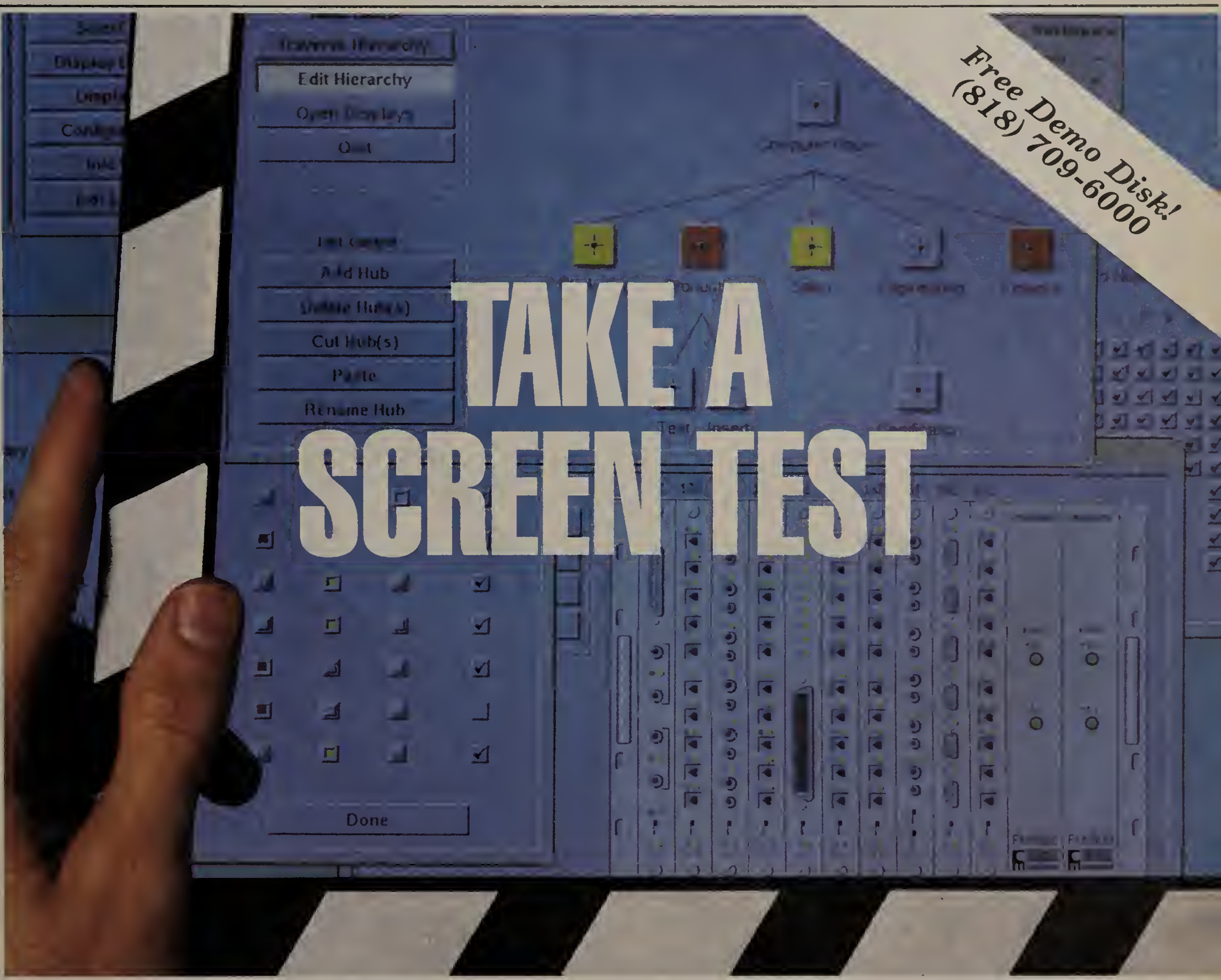
Global SDN also does not support many of the enhanced calling features that GVPN supports, such as calling party name display and automatic redial if a line is busy.

But in the U.S., many of the enhanced GVPN calling features can only be obtained via Northern Telecom private branch exchanges equipped with Integrated Services Digital Network software or via PBXs that interface to Northern Telecom's ISDN standard.

US Sprint began GVPN service to Hong Kong and the U.K. in May. Commercial GVPN service is scheduled to begin with Unitel Communications, Inc. of Canada, PTT Telecom of the Netherlands and International Digital Communications, Inc. of Japan in the first quarter of 1992.

US Sprint also currently offers

(continued on page 61)



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First Look

Andrew provides AS/400 gateway to DECnet users

Andrew Corp. recently unveiled its **NetLynx/5400e,** a gateway that enables users on Digital Equipment Corp. networks to establish links to IBM Application System/400 minicomputers.

The NetLynx/5400e is a stand-alone unit that can fit in a rack or be wall-mounted in a wiring closet. The device is based on an Intel Corp. 80186 microprocessor and comes with 512K bytes of memory, seven I/O coprocessors and an Ethernet terminal server.

It attaches to a DECnet local-area network and appears to local devices as a terminal server. A single twinaxial cable port links the unit to an AS/400.

Each gateway can establish as many as seven emulation sessions, and multiple gateways can be pooled with a common DECnet service name. Users emulate IBM 5251 terminals via Andrew's TruLynx/5251 and can conduct file transfer via Andrew or IBM file-transfer software.

NetLynx 5400e is available now for $5,995.

Andrew Corp., 2771 Plaza del Amo, Torrance, Calif. 90503; (213) 320-7126.

Digitech offers frame relay analyzer

Digitech Industries, Inc. recently announced an analyzer for monitoring, troubleshooting and certifying frame relay products and services.

The **Digitech Series 900** is outfitted with 32-bit digital signal processors that fits into an Intel Corp. 80386-based personal computer. Digitech claims the board operates as much as 30 times faster than other frame relay analyzers and said the device can monitor and emulate in real-time lines running up to T-1 speeds with 100% line utilization.

The Digitech Series 900 frame relay analyzer board costs $15,000 and comes with a single T-1 interface. A dual V.35/T-1 interface, which requires an extra slot in the personal computer, costs $1,500.

Digitech Industries, Inc., 68 Grove St., Ridgefield, Conn. 06877; (203) 438-3731.

Hayes intros new modem for V.32bis

ATLANTA — Hayes Microcomputer Products, Inc. last week announced a V.32bis modem that supports standard speeds up to 14.4K bit/sec and throughput with data compression at speeds up to 38.4K bit/sec.

The V-Series Ultra Smartmodem 144000 (Ultra 144), like the earlier Ultra 96, also has an integral X.25 packet assembler/disassembler that can support as many as four concurrent packet-switched network sessions.

Adherence to CCITT V.32bis enables the modem to support full-duplex communications at 14.4K, 12K, 9.6K, 7.2K and 4.8K bit/sec. The Ultra 144 is also compatible with 9.6K bit/sec V.32 modems and Hayes' proprietary 9.6K bit/sec V-Series modems, more of which have been installed than any other 9.6K bit/sec proprietary modem, according to Hayes.

At lower speeds, the modem is compatible with V.22bis (2,400 bit/sec), V.23 (1,200 to 75 bit/sec), V.22 (1,200 bit/sec) and V.21 (300 bit/sec).

Support for the CCITT's V.42bis data compression standard and the V.42 Link Access Procedure M (LAP M), an error control standard, enables the modem to support compression capabilities of 4-to-1, meaning the Ultra 144 can achieve throughput in optimal conditions at speeds up to 38.4K bit/sec.

Other compatibility

The Ultra 144 is backward-compatible with the Hayes Adaptive Data Compression technique used in the early V-Series, and MNP 5, both of which provide 2-to-1 compression and throughput up to 19.2K bit/sec.

Besides LAP M support, the Ultra 144 is backward-compatible with the LAP B error control method used with earlier V-Series modems. The device supports pulse and tone dialing over standard dial-up facilities and two-wire leased line connections.

The integral PAD supports point-to-point or point-to-multipoint X.25 packet-switched links and implements CCITT X.3, X.28 and X.29 standards. As many as four concurrent X.25 sessions can be supported using Hayes' AutoStream protocol to support and manage the sessions.

Hayes' Smartcom III communications software is said to shield users from the complexities of PAD commands, allowing such processes as the storage of access procedures.

The Ultra 144 will be available in North America next month at a price of $1,199. Users with Ultra 96 can upgrade to the 144 for $275.

For further information, contact Hayes at 705 Westech Drive, Norcross, Ga. 30092, or call (404) 449-8791.

Bridge ties 4 E-nets to FDDI backbone

Penril DataComm tool forwards 60,000 64-byte packet/sec across all four Ethernet segments.

By Maureen Molloy
Staff Writer

GAITHERSBURG, Md. — Penril DataComm last week introduced a multiport bridge that will enable users to connect as many as four local-area network Ethernet segments to a Fiber Distributed Data Interface backbone.

The Series 2500 FDDI Bridge is the first in a series of LAN internetworking products the company plans to introduce during the next year.

Penril currently manufactures modems and statistical multiplexers that are sold predominantly through value-added reseller channels.

The Series 2500 FDDI Bridge is based on Reduced Instruction Set Computer (RISC) technology and can forward nearly 60,000 64-byte packet/sec through all four Ethernet ports, enough to keep up with a worst-case traffic scenario.

The total filtering capacity of the five interfaces is 505,949 packet/sec — 14,880 packet/sec for each of the Ethernet ports and 446,429 packet/sec for the FDDI ring. This ensures that no packets are dropped even when the fiber and the Ethernets are being used at the maximum possible rate.

The bridge supports ANSI FDDI standards, IEEE LAN and bridging standards, and Transmission Control Protocol/Internet Protocol standards. It can be managed using the TCP/IP Simple Network Management Protocol, either through the network or out-of-band via an RS-232 port.

The device is a translating bridge that converts Ethernet traffic to FDDI format and vice versa. This allows Ethernet nodes to directly address nodes located on the FDDI ring and ensures interoperability with other FDDI bridges and routers.

It also supports the Spanning Tree Protocol, which enables bridges to interact using a common language and reroute data in the event of a failure.

Additionally, the company plans to introduce more interfaces for the bridge, including LAN or FDDI ports, as well as wide-area network interfaces operating at T-3 speeds. These future products will be offered as field upgrades and accomplished through software downloads from a management station.

Good timing

According to Marty Palca, an analyst at San Jose, Calif.-based Dataquest, Inc., the product's functionality will place it at the high end of the Ethernet-to-FDDI bridge market.

"It's a good product entering the market at the right time," said Palca, adding that the number of FDDI bridges sold this year is expected to be nearly twice those sold in 1990.

Jim Harrison, program manager at the META Group, a Westport, Conn.-based consultancy, said the product's advanced filtering capabilities could make it one of the leading Ethernet-to-FDDI bridges. He pointed out, however, that Penril must first establish a market presence in LAN internetworking before the product can achieve success.

The Series 2500 Bridge costs between $24,000 and $42,000, depending on configuration, and will be available next month.

For further information, contact Penril at 1300 Quince Orchard Blvd., Gaithersburg, Md. 20878, or call (301) 921-8600.

Ashton-Tate takes wraps off dBASE IV Server tool

By Timothy O'Brien
West Coast Bureau Chief

TORRANCE, Calif. — In its first bid for a share of the client/server data base market, Ashton-Tate Corp. recently announced dBASE IV Server Edition.

Ashton-Tate has positioned dBASE IV Server Edition as a front-end tool for users needing access to Microsoft Corp.'s SQL Server back-end data base.

The software runs in extended memory on DOS-based Intel Corp. 80286 personal computers, freeing up base memory for applications and providing users with ample extended memory for large data base applications.

Ashton-Tate said it will eventually offer support for other popular data base servers.

"Ashton-Tate has identified the gaps in its product line, and for the near term, its strategy is being built around dBASE IV. This product is a first step," explained William Higgs, a senior software analyst at Gartner Group, Inc./InfoCorp, a consulting firm based in Santa Clara, Calif.

Higgs said he expects Ashton-Tate's long-range plans to call for back-end data base server products using advanced data base server technology from Interbase Software Corp., which Ashton-Tate acquired this past spring.

The dBASE Server Edition includes dBASE SQL, Ashton-Tate's implementation of SQL integrated with its dBASE language. As a result, many existing applications written in dBASE SQL can access dBASE data stored locally in .dbf format. The same applications can also access remote server-based data base tables.

In addition, developers can write applications in dBASE SQL and then dBASE IV Server Edition will convert the programs into SQL Server's native SQL.

As future versions of dBASE IV Server Edition support other servers, developers will be able to make their applications available on a variety of servers without learning different SQL dialects.

"Users don't have to learn a new language to use SQL," said Bill Lyons, chief executive officer of Ashton-Tate, at a recent conference. "With this product, we have provided seamless integration to the back-end SQL Server."

System requirements include an 80286 computer with 640K bytes of base memory and 1M byte of extended memory. The system works with Microsoft SQL Server Version 1.1 running on an OS/2-based server.

Pricing for dBASE IV Server Edition is set at $1,295 for three users and $7,995 for 20 users. Current users of dBASE products can upgrade to dBASE IV Server Edition for $595. The product is available now.

For more information, contact Ashton-Tate at 20101 Hamilton Ave., Torrance, Calif. 90509, or call (800) 227-4866.

OPINIONS

NETWORK SERVICES

BY JOHN BUTLER

Guidelines for checking vendor references

When looking for a new source of network products or services, network managers often rely on references as a way to select a vendor. However, references are often based on subjective human perceptions, which can be distorted.

If The Friendly Service Co. gives you the name of a network manager — let's call her Ellie — as a reference, then what does it mean? Let's call Ellie and see if we can understand what is really behind her responses.

You reach Ellie and begin, "I'm considering using The Friendly Service Co. to service my network. How do you like their service?"

"It's great," she replies. (But what she might mean is, "I like Bill, my field engineer, but I don't care much for anyone else over there.")

"How about their response time?"

"They are always here when we need them." (Translation: "Business is slow, and we only need a 48-hour response. They manage that.")

"Tell me, Ellie, how about parts?"

"We have never been kept down for parts." (That is, "We have never needed parts to resolve a problem. Usually, an adjustment keeps us limping along.")

> A good salesman will check each reference and cue them if needed.
>
> ▲▲▲

"So I guess you would recommend using Friendly for our needs."

"Absolutely." (Meaning, "I don't know what your needs are, but I'd use any company as long as Bill is my field engineer. I hate change.")

Now don't get me wrong. You do need to rely to a great extent on references, but be careful how you use them. Be specific when you ask a question. Ask: "Do they get on site within two hours?" not: "Is the response time good?" Ask: "What happened the last time you needed a part?" not: "Is their parts support good?" If a lot of money is at stake, then consider a visit to a reference site.

Here are some other points to keep in mind when checking references:

- No one is going to give you a bad reference. A good salesman will check each reference and cue them if needed.
- It's unlikely that any user of a company's service will speak badly of that service, especially if they were involved in the selection of the vendor. After all, who wants to admit they made a bad decision?
- Talk to a person at the right managerial level. If you are given the name of a lower level manager or an operator, ask to talk with the MIS director or the network manager. The higher you go, the more likely you are to get an unbiased response.

When you evaluate the quality of the service you are getting from your current vendor, once again, sort out the facts from the perceptions. What is important to you in your decision is whether a change in vendors will affect your business operations. Weigh any change in network uptime against potential cost benefits.

There are numerous companies in the marketplace that want your business. Many of them can do a very good job. Your chances of finding the right vendor increase if you keep your decision as factual and objective as possible. ◼

Butler is a sales manager in Decision Data Service, Inc.'s Pawtucket, R.I., office.

NETWORK WORLD

Editor
John Gallant

Executive Editor
John Dix

Assistant Managing Editor — News
Charles Bruno

Senior Editors
Bob Brown — Industry Update
Barton Crockett — International Networking
Paul Desmond — Data Communications
Wayne Eckerson — Management Strategies
Eric Smalley — Local Networking
Bob Wallace — Telecommunications

Caryn Gillooly — Local Networking
5423 Gladewright Drive
Centreville, Va. 22020
(703) 266-1537
Fax: (703) 266-1543

Staff Writer
Maureen Molloy

West Coast Bureau
Timothy O'Brien — Bureau Chief
2088 Union Street, Suite 2
San Francisco, Calif. 94123
(415) 771-3530
Fax: (415) 771-2817

Washington D.C. Bureau
Anita Taff — Bureau Chief
(202) 879-6744
Ellen Messmer — Correspondent
National Place
1331 Pennsylvania Ave. NW, Suite 505
Washington, D.C. 20004
(202) 879-6752

Features Editor
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Alan Pearce

Teletoons
Phil Frank
Joe Troise

President/Publisher
Gary J. Beach

Director of Financial Operations
Mary Fanning

Network World
161 Worcester Road
Framingham, Mass. 01701
(508) 875-6400
MCI Mail — 390-4868
Fax: (508) 820-3467

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USER ADVISORY PANEL

Laurie Bride
Manager, Network Architecture
Boeing Computer Services

Roy Bruce
Senior Adviser
International Communications Association

Phillip Evans
Director, Telecommunications
FMC Corp.
President
International Communications Association

Len Evenchik
Director of Communications
The Commonwealth of Massachusetts

Thomas Festa
President
Wall Street Telecommunications Association

Lionel Gillerman
Telecommunications Services
McDonnell Douglas Aerospace
Information Services Co.
Vice-President for Regulatory Affairs
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Hughes Aircraft Co.
Chairman, User Alliance for Open Systems

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General Motors Corp.

Ron Kopitowsky
Telecommunications Director
Metropolitan Transportation Authority, New York State
President, Communications Managers Association

Donna Kwak
Senior Vice-President
Chase Bank of Arizona
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Network Administrator
United Parcel Service, Inc.

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Michael Toto
President
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Stanley Welland
Manager, Corporate Telecommunications
General Electric Co.

EDITORIAL

Brave new world of public net services holds promise, threat

Over the horizon, a wealth of powerful, new network services are taking shape that promise to revolutionize the public and private networks of today.

Users sampling some of these services, such as frame relay and Switched Multimegabit Data Service, are getting a taste of the greater flexibility and capacity of tomorrow's intelligent network.

These emerging technologies will serve as the foundation for the next generation of applications, including imaging, interactive video communications, multimedia systems and true distributed processing.

But this network vision has a dark side that has already been glimpsed, if only briefly. It raises unsettling questions about the future.

The intelligent network will be driven by increasingly sophisticated transmission facilities and hardware and software systems that are vulnerable to devastating outages.

As users know from painful experience, a single fiber cut can disrupt communications along an entire coastline or throughout a major city.

Deployment of Common Channel Signaling System 7 (CCS7) technology, which will be at the heart of the advanced services of the future, raises additional concerns.

In the past two weeks, Pacific Bell and Bell Atlantic Corp. both suffered a number of network outages in major cities — including Los Angeles, Pittsburgh, San Francisco and Washington, D.C. — due to problems with their CCS7 nets. Reports of other CCS7-related local-loop problems are also starting to emerge.

In January 1990, AT&T was hit hard by a CCS7-related nationwide network outage.

Carriers need to take steps now to inoculate their networks against future outages.

First, the carriers must establish redundancy in their CCS7 networks and erect fire walls that prevent a problem on one net from spreading into others.

This is particularly important in light of the fact that carriers plan to extend their signaling nets to user sites. A problem spawned by one user could disrupt many others.

Second, carriers must exercise the greatest caution in upgrading or modifying these vital signaling nets to prevent the sudden emergence of problems that are hard to pinpoint.

But the burden of protection does not lie solely with carriers. Users must ensure that their own networks are protected — through diverse routing, alternate carriers and disaster recovery planning — from the problems that are certain to emerge along the road to the intelligent network of the future. ◼

OPINIONS

DAWN OF OPEN SYSTEMS

BY JAMES HERMAN

Industry consolidation could short-circuit user needs

Conventional wisdom in the data communications industry says we are headed toward an open systems future.

The dawning of the open systems era is expected to usher in a period of even greater competition among vendors and swing the balance of industry power away from vendors in favor of users. Other factors at work in the industry, however, could produce a far different outcome.

There are many signs that the data communications industry is entering a period of vendor consolidation. AT&T's acquisition of NCR Corp. and Network Systems Corp.'s purchase of Vitalink Communications Corp. are two recent examples. Even the recent deal between IBM and Wang Laboratories, Inc., although not an acquisition, puts Wang squarely in IBM's sphere of influence.

In addition, the IBM-Wang alliance may be a precursor of how industry alignments will develop in the near future.

Over the next five years, the industry may fracture into a few large blocs of vendors that unite through various OEM, licensing and technology-sharing agreements. The computer industry could end up resembling the auto industry, in which thousands of participants are organized via a plethora of alliances and supplier agreements into five or six multinational groups.

As the consolidation and alignment proceeds, midsize vendors will continually scramble for protection. Like a high-stakes version of musical chairs, no one will want to be left standing when the music stops.

Ironically, it is the dramatic decline in the cost of technology, largely the result of standards, that will drive industry consolidation. Most of the basic building blocks of networks and information systems (IS) are becoming incredibly inexpensive. Good personal computers are available for less than $1,000, while local-area networks can be purchased for less than $100 per station.

It's easy to imagine a personal computer with the power of an Intel Corp. 80386 for under $500 and a router for less than $1,000 by 1995 — prices that put them in the realm of mass-market consumer technology. This development will force information technology vendors to think more like consumer electronics giants such as Sony Corp. and Mitsubishi Consumer Electronics America, Inc. if they hope to succeed.

If net equipment is priced like a consumer product, it also must be distributed and serviced like a consumer product.

High-volume, low-margin consumer products are sold through distributors and catalogs — the kinds of channels that all the major vendors have already set up. In the future, the major vendors' primary source of market power may result from their control of key distribution channels, which they will use to further cement supplier agreements with other vendors.

For users, the trend toward consolidation could be a mixed blessing. On one hand, users must be careful in their choice of vendors so they don't get stuck with a vendor that goes under, a consideration that may actually accelerate the consolidation trend since users may become reluctant to use anyone other than the most solid vendors.

On the other hand, users will benefit from the increased level of integration and interoperability that will come from vendor alliances.

As the vendors sort out their allegiances to one another and distinct camps emerge, users will once again be able to return to the strategic vendor model.

For the past five years, most users have watched the number of IS vendors they used increase significantly due to the fact that their traditional vendors were unable to keep up with all the latest advances in technology. Now they are likely to see that number decline as the big vendors use alliances and acquisitions as a source for products they can't produce themselves.

Traditionally, companies' use of diverse vendors has been due to decentralized purchasing policies that have let departments and work groups make their own purchasing decisions.

Now the legacy of incompatible and unmanageable systems is fueling a return to strong enterprisewide standards. As users reduce the number of information technology suppliers, they will see a corresponding decrease in the complexity of integration and systems management.

When users return to the strategic vendor approach, however, it is crucial that they insist on across-the-board use of open systems standards.

Open systems standards offer a way to balance the growing power of the surviving vendors by lowering the cost of switching to another vendor. Adopting an open systems strategy allows users to purchase from two or three vendors — just enough to keep everyone on their toes.

Consolidation isn't going to happen overnight, but neither is migration to open systems.

Users must recognize that the next few years may be their window of opportunity to institutionalize open systems standards and the corresponding benefits of interoperability and portability. If users remain locked into current proprietary technology, they may be hurt or end up captive to a surviving multinational computer giant.

Instead, users must have the option to switch strategic vendors. Getting serious about open systems will ensure that such an option exists. It will also prevent the coming consolidation from turning into a nightmare. ◘

Herman is a principal at Northeast Consulting Resources, Inc., a Boston consulting firm that focuses on strategic management and information technologies.

LIKE ALLIGATORS IN A SWAMP, unforeseen problems can really put the bite on a communications operation. Many managers find themselves wrestling with these networking reptiles every day.

If you've survived an "alligator attack," share it with our readers by calling Susan Collins, associate features editor, at (508) 820-7413 or fax your idea to us at (508) 820-3467. Alligators should be 1,200 words in length and submitted either on disk or via modem.

TELETOONS

BY FRANK AND TROISE

But.. I didn't go on unauthorized vacation for two weeks.. I was in the wiring closet!
NETWORK MANAGER

LETTERS

An ounce of prevention

As an information systems auditor for Central Fidelity Banks, Inc., I have a comment on your recent article "Net managers focus on virus prevention" (*NW*, May 27): It's about time!

When are so-called computer professionals going to wake up? Prevention has been the answer since the beginning of the first virus.

Most security problems relating to personal computer and local-area network environments can be directly attributed to a lack of or inadequacies in corporate standards. The very standards that govern mainframe computer uses are ignored at this level.

Using standard security measures is more effective in stopping virus attacks than any software product on the market. The only cost is the time required for your corporate staff to develop them. Of course, developing and refining end-user computing standards will take time but making them effective at deterring viruses will pay for itself many times over.

Leave the deterrence of viruses to proper standards, user education and heavy penalties for violations. Detection has its place, but detecting the intended subject by securing your system's accessibility is more productive than gaining false reliance on vaccines that are only as good as their developers.

Hal Shearer
Senior IS auditor
Central Fidelity Banks
Richmond, Va.

Zmodem support

Your recent article "New Mac software supports emulation and file transfer" (*NW*, June 17) stated, "One of the product's unique features is its support of the Zmodem proto-

(continued on page 61)

Network World *welcomes letters from its readers.*

Letters should be typed and double-spaced. Mail them to Editor, Network World, *161 Worcester Road, Framingham, Mass. 01701.*

Letters may be edited for space and clarity.

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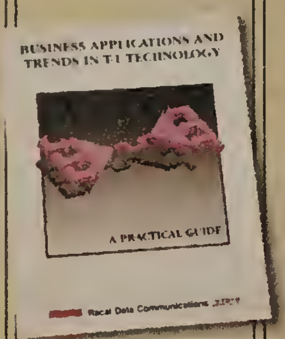

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DATACOM

BUYER'S GUIDE

T-1 AND T-3 MULTIPLEXERS

A mix of muxes

CONTINUED FROM PAGE 1

vendor to work with in designing their T-1 or T-3 networks. Indeed, there have been signs of flux in the crowded multiplexer market, where acquisitions have already affected some early entrants.

For example, Timeplex, Inc. has changed hands twice. Unisys Corp. bought the multiplexer vendor in 1988 for $330 million and sold it last month to a joint venture of Swiss and South African telecommunications suppliers and resellers. Avanti Communications Corp., another early entrant in T-1 multiplexing, saw its assets acquired by start-up TyLink Corp. of Norton, Mass., earlier this year. Avanti still exists as a company, but its multiplexers are being made and marketed under the TyLink name.

The result of market changes and rapid growth has been an exceptionally broad array of products with incompatible multiplexing schemes, framing algorithms and management systems. This makes it all the more important for users to consider the following points when selecting a multiplexer:

- Compatibility with other vendors' equipment.
- Future migration paths and vendor plans for introducing new technologies.
- Scalability of the equipment.
- T-3 capability of the equipment.

The chart beginning on page 40 compares the basic, across-the-board features of more than 40 products from 38 vendors.

The vast majority of these vendors use proprietary algorithms to organize data bits into frames, which are then transmitted over the T-1 or T-3 circuit. To be able to understand the data being transmitted, the multiplexers on the receiving end must use the same algorithm.

According to the vendors, these different framing algorithms are not really causing problems because users are simply buying all their multiplexers from one vendor. But users disagree, saying that these incompatibilities limit their choices.

CHART • GUIDE

A Buyer's Guide chart comparing T-1 and T-3 multiplexers begins on page 40.

Users seeking T-1 and T-3 multiplexers will find plenty of choices.

For example, one user who is adamant about the need for compatibility is Steve Baker, president of Integrated Network Services, Inc. (Insinc), a Vancouver firm that does outsourcing and systems integration. Baker's firm handles voice and data traffic for more than 200 user firms, each with different customer premises equipment.

"You've got to find the [multiplexer] vendor that talks with the most other [multiplexers]," Baker says.

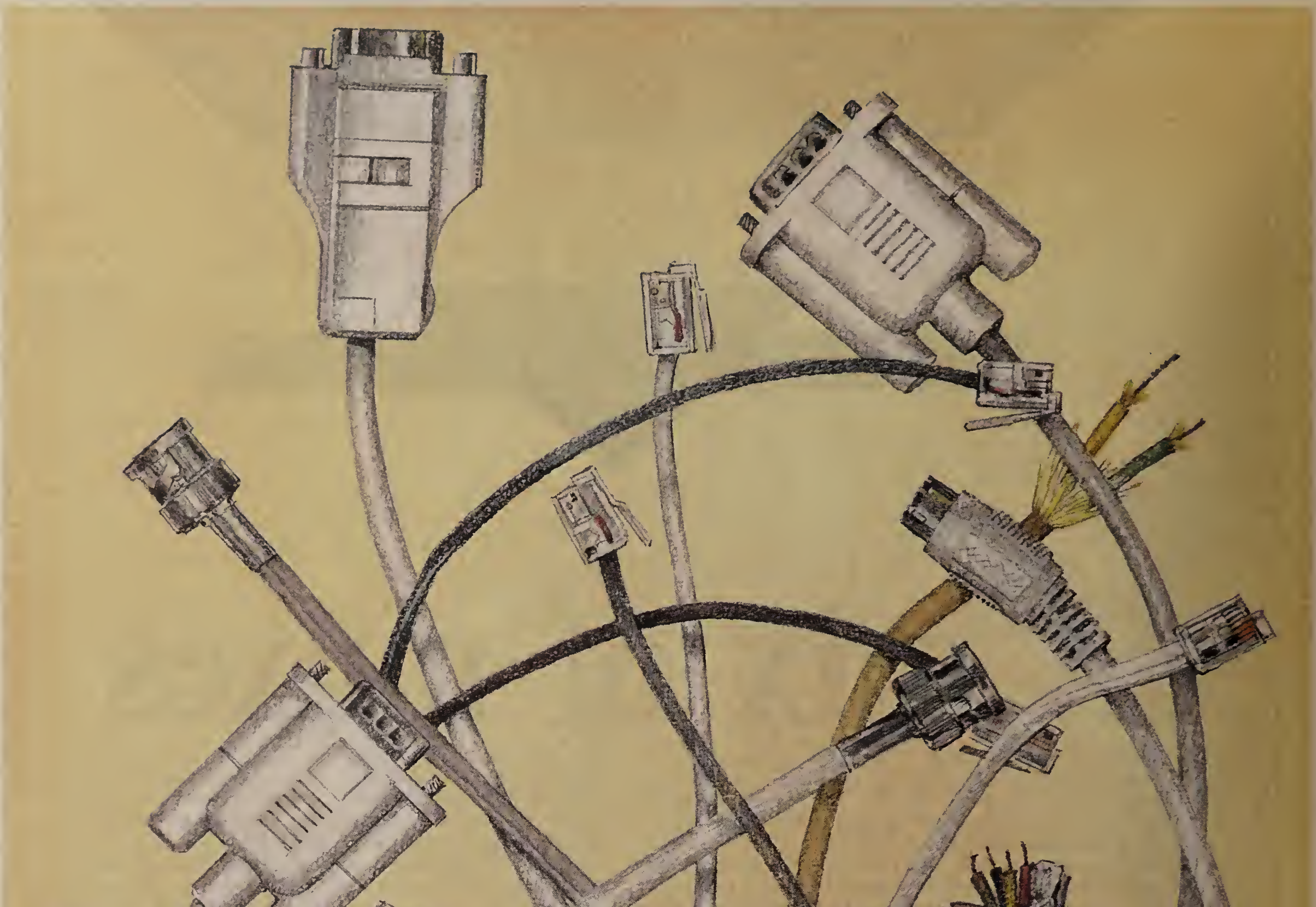
Even vendors admit incompatibilities effectively limit users to a single vendor's multiplexer. Vendor efforts in frame relay and ATM should alleviate this situation somewhat, as these schemes define standard interfaces among different vendors' equipment.

Some vendors are even building multiple multiplexing schemes into their products. AT&T Paradyne, for example, combines its proprietary multiplexing scheme with carrier-standard M24 multiplexing to provide a measure of compatibility with other devices.

Another area of potential in-

(continued on page 38)

Briere is a Network World *contributing editor and president of TeleChoice, Inc., a Montclair, N.J., telecommunications consultancy specializing in long-distance service analysis and network design. Guptill is an associate at TeleChoice. They can be reached at (201) 746-0200.*



NETWORK PERSONAL

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Packet protocols that will affect muxes

T-1 multiplexers, which are overwhelmingly circuit switches, are likely to undergo significant architectural changes over the next few years as vendors develop support for packet-switched approaches such as frame relay and Asynchronous Transfer Mode (ATM).

Frame relay is becoming an important checklist item for users currently planning networks to handle high-speed, bursty data traffic — particularly those that interconnect local-area networks. ATM switching is a longer range issue but will become important when users start planning to use T-1 multiplexers to access broadband Integrated Services Digital Network offerings.

So far, only a few T-1 multiplexer vendors have added frame relay to their multiplexers. Datalink Ready, Inc. and StrataCom, Inc. and are joined by Netrix Corp. as the only three vendors listed in the Buyer's Guide chart to currently support frame relay. About 18 others — including Network Equipment Technologies, Inc., Newbridge Networks, Inc. and Timeplex, Inc. — plan to offer frame relay at some point, while 17 currently have no plans to offer frame relay.

Vendors support frame relay by adding a frame relay interface board to the multiplexer. Users connect LAN bridges or routers to the interface, which breaks LAN traffic into frames of varying length in much the same way a packet assembler/disassembler creates X.25 packets.

Users allocate a specific amount of bandwidth, whether it is a full T-1 or a chunk of a T-1 such as a 256K bit/sec channel, to carry frames to other sites with LANs or host computing facilities. When frame relay data needs to be transmitted, the entire amount of allocated bandwidth is made available.

The best method?

While suitable for LAN interconnect applications, frame relay may not be the best technology to use when transmitting voice or video because it cannot guarantee the fixed uniform delay and sampling needed by those applications. The equipment used to process voice and video transmissions requires regular, constant samples, which frame relay is currently unable to provide.

The ATM draft international standard was designed for precisely this purpose, however. The standard defines a form of packet switching called cell relay, which breaks data sent to an ATM switch into fixed-length cells.

Each cell is 53 bytes and consists of a 5-byte header and a 48-byte information field. The header is used to relay cells through a series of switches at high speed. The switch passing data to the intended receiving device reassembles the original data stream.

ATM will be used by carriers worldwide to deploy broadband ISDN, a set of standards defining interfaces that allow information to be exchanged at broadband rates. Broadband ISDN specifies a single signal interface for voice, data, video, and circuit- and packet-switched data at high speeds (greater than 2M bit/sec).

The CCITT 1988 broadband ISDN Recommendation I.121 includes a user network interface definition at speeds of 150M and 600M bit/sec to take advantage of the gigabit speeds promised by the proposed Synchronous Optical Network standard. I.121 recommends that broadband ISDN services be delivered using ATM's cell-based networking protocols.

So far, no multiplexer supports ATM, though some vendors have announced plans to offer it on T-3 multiplexers and frame relay on their T-1 multiplexers. The reason, they say, is that at T-3 speeds, ATM offers better efficiencies for transmitting data than frame relay offers. This is because ATM is designed to transport voice, data, video, images and virtually anything else that can be digitized in fixed-length cells instead of variable-length packets.

— Daniel Briere and Bruce Guptill

(continued from page 35)

compatibility between multiplexers is the interleaving method used.

The vast majority of vendors use either bit interleaving or byte interleaving. However, very few, including StrataCom, Inc., use packet interleaving. A bit-interleaved multiplexer will not work with a byte-interleaved one, and a packet-interleaved multiplexer won't work with either of the other two.

In bit interleaving, the multiplexer builds a data frame using one bit from each input port at a time. The frame is then transmitted into the network. In byte interleaving, the multiplexer builds frames a byte at a time from each input port.

In packet interleaving, multiplexers build packets, not frames, in groups of characters — usually between one and 256 characters — and then send those packets onto the network as they become ready to transmit.

Bit interleaving typically requires less memory than byte interleaving, due to the smaller chunks of data handled at one time from each input channel. They, therefore, also have relatively short delay time when sending and receiving information between network nodes. Of course, bit transmission requires disassembling and reassembling the messages sent and received, and requires extra control characters to do this.

The interleaving scheme used by each vendor is listed in the accompanying chart.

Bit interleaving typically requires less memory than byte interleaving.

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Another issue for users to consider is whether the multiplexer is compatible with generally accepted public network interfaces. M24 multiplexing capability, for instance, can allow an otherwise proprietary multiplexer to work with customer premises equipment from other vendors.

The multiplexer should be compatible with all major customer premises equipment and public network interface standards, including 2-wire E&M, 4-wire E&M, D4 framing, EIA-232-D (RS-232-C), CCITT V.35, EIA-422-A (RS-422) and EIA-530 (RS-449). Again, we have listed such compatibility as reported by the vendors in the chart.

Other standard interfaces that users should look for include Integrated Services Digital Network Basic Rate Interface (BRI) and Primary Rate Interface (PRI), as well as European T-1 and E-3 networks for multinational networking.

Since various countries differ in their interpretations of standards, users planning to communicate with offices in another country should make sure the post, telegraph and telephone administration of the country in question has certified a multiplexer as comparable with its services.

Users should also ask whether the multiplexer supports CCITT G.700 series interfaces, including G.703 and G.736. These are established international standards for T-1/E-1 multiplexer interfaces with public networks.

Users should query vendors about their plans to support future technologies that are now being standardized, such as frame relay and ATM. "Your multiplexers must be prepared for the future," says Insinc's Baker, who sees frame relay and ISDN compatibility as necessary capabilities in a multiplexer.

Three of the 38 vendors surveyed for this Buyer's Guide — Datalink Ready, Netrix Corp. and StrataCom — currently offer frame relay support. Northern Telecom, Inc.'s product supports frame relay throughput as an intelligent channel bank, but does not support frame relay switching. Eighteen others plan to support frame relay in the near future.

Ask vendors how they plan to add support for these and other technologies in future products, and if current products will be enhanced to support these new technologies. Such backward compatibility is of paramount importance, especially in large networks with a broad base of installed equipment and software.

Also investigate the vendor's history of innovation. Has the vendor demonstrated a willingness and ability to use new technologies? Have these technologies been supported by the vendor?

Users and vendors consider the advent of ATM a factor that will help alleviate concerns of multiplexer incompatibility. Fortunately, most vendors plan to support ATM (see "Packet protocols that will affect muxes," this page).

Scalability

Twenty-eight of the 38 vendors featured in the chart say their listed multiplexer is scalable. Upgrades can include adding or swapping out cards that boost a multiplexer's channel handling capacity; installing cards, other hardware or firmware to provide network management functions; or taking advantage of programming hooks into the multiplexer so the user can configure its networks right at the chassis. The least expensive upgrades tend to be the card-swapping type; channel cards can be bought for as little as $250 each.

Programmable network management is found at the high end of the upgrade spectrum. While this is often built into the multiplexer at the factory, it also can be added through the installation of more cards with processors and preprogrammed instruction sets for various functions. Prices are dependent upon the type and amount of management software to be installed, which is determined by the hardware, the card firmware and the software needed to support those cards. Net management upgrade costs range between $500 and $1,000 per card.

The least expensive upgrades tend to be the card-swapping type.

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Management

The multiplexer is the heart of the user's network, providing switching, transmission and reception for all data sent over the backbone. Therefore, the net manager must manage the network through the multiplexer in

(continued on page 48)

Channel bank vs. mux

For a small or fairly stable T-1 network, channel banks provide most, if not all, of the functionality needed.

Channel banks are the simplest form of multiplexer, with network switching accomplished using manual, dual inline pin switches. The advantage of channel banks is their lower cost, simplicity and adherence. If you plan to simply link two or three sites using T-1 lines, you may be a candidate for channel banks instead of multiplexers.

On the other hand, if you are setting up a corporate backbone or feeding data from remote offices to an existing backbone, multiplexers are the better choice.

There are differences between the feeder multiplexers used in the latter application and the resource manager multiplexers that anchor the corporate backbone. But these differences are a function of the capabilities built into the multiplexers and the scalability of the multiplexers through the installation of function cards and software. The multiplexers themselves may not be very different physically.

Some vendors offer channel banks that can be upgraded into multiplexers using the same chassis or rack space. The DCB-24 channel bank from Telco Systems Network Access Corp., for example, can be upgraded into the company's Route 24 T-1 multiplexer simply by replacing the channel cards.

— Daniel Briere and Bruce Guptill

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T-1 and T-3 multiplexers

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum non-redundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatiblity (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Adaptive Corp. **A Network Equipment Technologies, Inc. company** **Redwood City, Calif.** **(415) 366-9500**	STM-18 SONET Transmission Manager (T-3; bit-oriented, floating SONET virtual tributary)	Circuit; frame relay support not planned	336 T-1, 18 T-3; NA	RS-232, D4/DS1, V.35, DS3; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, DS3, microwave, satellite, fiber-optic, twisted-pair	500; 336	32 HSSI	NA	Synchronous: HSSI up to 43M bit/sec	DSO, subrate, B8ZS, DACS	Integrated event log; interface to NET's NET/OPEN network management system	Standard: dynamic bandwidth allocation, channel prioritization, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	$200,000 (estimate; product not available until fourth-quarter 1991)/90 days
Astrocom Corp. **St. Paul, Minn.** **(612) 227-8651**	NX6456-DS1 (T-1; byte)	Circuit; frame relay support not planned	1 T-1, 24 56K bit/sec	RS-422, RS-449, D4/DS1, V.35; data, video	Point-to-point, multipoint, drop-and-insert; T-1/DS1, twisted-pair	4; 1	Asynchronous: NA; synchronous: 4 or more DS1s	NA; NA	Asynchronous: NA; synchronous: 56K bit/sec to 1.5346M bit/sec; N X 56 or N X 64, where N = 1 to 24	DS0, B8ZS, DACS	Local, remote and digital loop-backs; none	Standard: user-programmable features, supervisory port; optional: redundant power supply	$4,500-$6,000/2 years
AT&T Paradyne **Largo, Fla.** **(813) 530-2000**	ACCULINK Series (T-1; bit and byte)	Circuit; frame relay support planned	16 T-1; 154 9.6K bit/sec, 27 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.35, MIL-188, E&M 1, 2; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic	250; 16	Asynchronous: 128; synchronous: 128	Analog: 61, digital: 192; ADPCM: 24K and 32K bit/sec, PCM: 64K bit/sec	Asynchronous: 300-19.2K bit/sec; synchronous: 1,200-1.536M bit/sec	Proprietary and non-proprietary muxing schemes; DS0, subrate, B8ZS, DACS	Fully integrated management from a single point of control, integrated BERT, integral ESF statistics, channel/DS0/DS1/CSU/OCU/DSU loop-backs, voice test tone, DTE interface status, noninterfering diagnostic checks, performance statistics, automatic fault reporting; optional interfaces: UNMA/Accumaster Integrator, NetView	Standard: dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, user-programmable features, supervisory port; optional: redundant power supply, tandem switching, primary alternate route selection	$5,500-$80,000/1 year on-site
Bayly Communications, Inc. **Ajax, Ontario** **(416) 686-2935**	Omniplexer-Omnidacs Family (T-1; bit)	Circuit; frame relay support not planned	2-34 T-1; 120-240 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.35, E&M 1, 2, 3; voice, data, video, image	Point-to-point, multipoint, ring, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	Unlimited; 2-34	Asynchronous: 60-288; synchronous: 60-480	48-96; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 0-19.2K bit/sec, synchronous: 0-19.2K bit/sec, 56K bit/sec, N X 56K/64K bit/sec; Omnidacs model: 300 bit/sec-1.544M bit/sec	Asynchronous multiplexing scheme is proprietary; DSO, Subrate, B8ZS, DACS	Control of hardware parameters and DS0 routing; indications of port and node failure; none	Standard: E-1 circuits, sub-DS0 bandwidth allocation, channel prioritization, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$2,500-$35,000/1 year parts and labor
Canoga Perkins Corp. **Chatsworth, Calif.** **(818) 718-6300**	Model 3140 (T-1; byte)	Circuit; frame relay support not planned	2 T-1, 192 9.6K bit/sec, 24 56K bit/sec	Point-to-point, multipoint, ring, drop-and-insert, bypass; RS-232, RS-422, RS-449, V.35, E&M 1, 2, 3, 4, 5; voice, data, image, video	T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	32; 2	Asynchronous: 240, synchronous: 150	30; PCM: 64K bit/sec, ADPCM: 16K and 32K bit/sec	Asynchronous: 0-38.4K bit/sec; synchronous: 0-1.536M bit/sec	DSO, subrate, B8ZS, DACS	Local and remote loopback, LED displays, control logic; management interfaces planned	Standard: E-1 circuits, sub-DSO bandwidth allocation, user-programmable features, supervisory port; optional: redundant power supply, primary alternate route selection	$4,600-$15,000/1 year
Codex Corp. **Mansfield, Mass.** **(508) 261-4000**	Codex 6250 Digital Network Multiplexer (T-1, byte)	Circuit; frame relay support not planned	4 T-1; 120 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-449, D4/DS1, V.11/X.21, V.35, V.36, G.703, E&M 1, 5; voice, data, image, video	Point-to-point, multipoint, drop-and-insert, bypass, T-1 to 56K bit/sec DDS; T-1/DS1, microwave, satellite, DDS, CEPT E-1	10; 3	Asynchronous: 72, synchronous: 72	72; PCM: 64K bit/sec, ADPCM: 16K, 24K and 32K bit/sec	Asynchronous: 300-19.2K bit/sec, synchronous: 2,400K-768K bit/sec; voice: 16K-64K bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	Network event recording and display, system recognizes standard AT&T red and yellow alarms; Standard interface: Codex 9800 series	Standard: E-1, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$8,000-$50,000/1 year
Cylink Corp. **Sunnyvale, Calif.** **(408) 735-5800**	8100 Network Integrator (T-1, byte)	Circuit; frame relay support planned	2 T-1; 40 9.6K bit/sec, 8 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.11, V.35; voice, data	Point-to-point, multipoint, ring, drop-and-insert, bypass; T-1/DS1, twisted-pair, CEPT E-1	1,024; 2	Asynchronous: 40; synchronous: 8	16; ADPCM: 32K bit/sec	Asynchronous: 1,200-9.6K bit/sec, synchronous: 1,200-2M bit/sec	DSO, subrate, B8ZS, DACS	Bit error rate measurement network and data terminal equipment loop-back, network performance monitoring; ASCII command-line interface	Standard: user-programmable features, supervisory port; optional: E-1 circuits, dynamic bandwidth allocation, sub-DSO bandwidth allocation, channel prioritization, redundant power supply	$4,000-$15,000/2 year
Datalink Ready **Melbourne, Fla.** **(407) 676-0500**	Megaplex (2) (T-1; byte)	Circuit; currently supports frame relay	1 T-1, 20 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.11, V.35, E&M 1 & 2; voice, data, video	Point-to-point, multipoint; T-1/DS1, microwave, satellite	11; 1	Asynchronous: NA; synchronous: 10	1; ADPCM: 32K bit/sec	Asynchronous: NA; synchronous: 0-768K bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	None; none	Standard: dynamic bandwidth allocation, user-programmable features, supervisory port	$5,000-$7,700/1 year

ADPCM = Adaptive differential pulse code modulation
B8ZS = Bipolar eight zero code substitution
BERT = Bit error rate tester
CEPT = Conference Europeenne des Postes et Telecommunications
CMIP = Common Management Information Protocol
CMIS = Common Management Information Services
CSU = Channel service unit
CVSD = Continuously variable slope delta
DACS = Digital access and cross-connect system

DDS = Digital data service
HSSI = High-speed serial interface
MIL = U.S. military specification
NA = Not applicable
PCM = Pulse code modulation
SNMP = Simple Network Management Protocol
SONET = Synchronous Optical Network
UNMA = AT&T's Unified Network Management Architecture
VAPC = Vector adaptive predictive coding

FOOTNOTES:

(1) "Proprietary" indicates that the vendor uses a proprietary multiplexing scheme; the other answers in this category list the various areas of public network standards with which the vendor's product is compatible.
(2) This product is not manufactured by the firm listed.
(3) This product is based on standard RBHC D4 mechanics. As such, multiple line interfaces from several vendors are compatible.
(4) Any mix of T-3 and T-1 circuits can be configured up to a maximum of 360 T-1 equivalents. The system conforms to applicable DS3 and DS1 standards.
(5) The INpath is an access multiplexer optimized for carriers/service providers (interexchange carriers, local exchange carriers, alternate access carriers).

This chart includes a representative selection of T-1 and T-3 mux vendors. Vendors not included may offer a full range of competitive products.

SOURCE TELECHOICE, INC MONTCLAIR N J

T-1 and T-3 multiplexers (continued on page 44)

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum non-redundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatibility (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Dataproducts New England **Wallingford, Conn.** **(203) 265-7151**	Axxess Series (T-1, byte)	Circuit, packet; frame relay support planned	2 T-1; 48 (or more) 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, V.11, V.35, MIL-188, E&M 1, 3, 5; voice, data, image, video	Point-to-point, ring, tandem, drop-and-insert, bypass, subrate drop-and-insert/bypass, hybrid public/private; T-1/DS-1, microwave, satellite	16; 2	Asynchronous: 48; synchronous: 24	48; PCM: 64K bit/sec, ADPCM: 32K bit/sec, CVSD: 12K-64K bit/sec, proprietary: 4.8K, 7.2K and 14.4K bit/sec	Asynchronous: 19.2K bit/sec, synchronous: 512K bit/sec	Proprietary muxing scheme; DS0, subrate, B8Zs, DACS	Self-test, local and remote loop, cyclic redundancy checks, Integral extended superframe format CSU; management interfaces planned	Standard: E-1 circuits, dynamic bandwidth allocation, sub-DSO bandwidth allocation, channel prioritization, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply, tandem switching	$3,900-$8,000/1 year
Data Switch Corp. **Shelton, Conn.** **(203) 926-1801**	Model 9400/9200 ChannelPlexer (T-1, T-3, proprietary)	Proprietary nonswitching technology; frame relay support not planned	2 T-1, 2 T-3; NA	IBM channels; IBM or compatible (S/370 or S/390)	Point-to-point, multipoint; T-1/DS1, CEPT 1, CEPT 3, direct attach to mainframe channel	2; 2	NA (channel multiplexer, supports up to 8 channels per end)	NA; NA	Up to 4.5M byte/second	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	Standard system controller with alerts and diagnostics; standard interface: IBM NetView through Data Switch's TotalNet system.	Standard: E-1, channel prioritization, redundant power supply, primary alternate route selection	Starts at $65,000 per link/90 days
Dowty Communications, Inc. **Cherry Hill, N.J.** **(609)424-4451**	DCP 9000 (T-1/E-1, byte)	Circuit; frame relay support planned	10 T-1 (40 planned); 120 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.11, V.35, DDS (4-wire), foreign exchange, office, foreign exchange subscriber, E&M 1, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, twisted-pair	More than 100; 10	Asynchronous: 96; synchronous: 120 (nodes support up to 10 times these numbers)	460; ADPCM: 32K, 16K bit/sec	Asynchronous: up to 38.4K bit/sec, synchronous: up to 1.536M bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	ASCII terminal for point-to-point muxs, IBM PS/2 for nodal processors; none	Standard: dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; optional: E-1 circuits, redundant power supply	Point-to-point mux: $4,000-$15,000 and up; Nodal Processor: $16,500-$75,000 and up/1 year
DSC Communications Corp. **Plano, Texas** **(214) 519-3000**	CP3000, CP/4000 (T-1, E-1)	Circuit; frame relay support not planned	34 T-1 or E-1; 120 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.11, V.35, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, E-1	Unlimited; 34	Asynchronous: 64; synchronous: 120	72; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 1.2K, 2.4K, 4.8K, 7.2K, 9.6K, 14.4K, 16.8K, 19.2K bit/sec; synchronous: 1.2K, 2.4K, 4.8K, 7.2K, 9.6K, 14.4K, 16.8K, 19.2K, 28.8K, 38.4K, 148K bit/sec and N X 56, N X 64, where N = 1-30	DS0, subrate, B8ZS, DACS	Full DDS testing integrated, built-in BERT patterns on every data card, integral menu-driven operator interface; standard interfaces: X.25 machine language port for network management system connection, optional interfaces: module for aggregating remote management traffic into an X.25 format	Standard: E-1, sub-DS0, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	$9,500-$57,000/1 year
Equinox Systems, Inc. **Melbourne, Fla.** **(305) 255-3500**	TDM-48 (T-1, bit)	Circuit; frame relay support not planned	1 T-1; 49 9.6K bit/sec, 0-56K bit/sec	RS-RS-232, D4/DS1; data	Point-to-point, can be connected to Equinox data switching hub; T-1/DS1, microwave, twisted-pair	1; 0	Asynchronous: 48; synchronous: 0	0; NA	Asynchronous: 19.2K bit/sec; synchronous: NA	Proprietary muxing scheme	Local and remote loop-back; Equinox Data PBX	Standard: supervisory port	$3,600/3 years
Fibermux Corp. **Chatsworth, Calif.** **(818) 709-6000**	Magnum FX4400 (T-3, bit)	Circuit; frame relay support not planned	24 T-1, 1 T-3; NA	RS-232, RS-422, RS-449, D4/DS1, V.35, MIL-188; voice, data, image, video	Point-to-point, ring; DS3, microwave, fiber-optic	8, 1	Asynchronous: 256; synchronous: 256	576; T-1 input to DS3	Asynchronous: 19.2K bit/sec; synchronous: 9.5M bit/sec	Proprietary muxing scheme; B8ZS	Proprietary MS-DOS alarm and troubleshooting software; optional interface: NetView PC interface	Standard: dynamic bandwidth allocation, user-programmable features; optional: E-1, redundant power supply, supervisory port	Starts at $5,250/1 year

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B8ZS = Bipolar eight zero code substitution
BERT = Bit error rate tester
CEPT = Conference Europeenne des Postes et Telecommunications
CMIP = Common Management Information Protocol
CMIS = Common Management Information Services
CSU = Channel service unit
CVSD = Continuously variable slope delta
DACS = Digital access and cross-connect system

DDS = Digital data service
HSSI = High-speed serial interface
MIL = U.S. military specification
NA = Not applicable
PCM = Pulse code modulation
SNMP = Simple Network Management Protocol
SONET = Synchronous Optical Network
UNMA = AT&T's Unified Network Management Architecture
VAPC = Vector adaptive predictive coding

FOOTNOTES:

(1) "Proprietary" indicates that the vendor uses a proprietary multiplexing scheme; the other answers in this category list the various areas of public network standards with which the vendor's product is compatible.
(2) This product is not manufactured by the firm listed.
(3) This product is based on standard RBHC D4 mechanics. As such, multiple line interfaces from several vendors are compatible.
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SOURCE: TELECHOICE, INC , MONTCLAIR, N J

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Models 35, 40 and 57 SX feature i386 SX 20 MHz processors, 16-bit VGA and 5.25″ internal drive capability. 80/160MB hardfiles are available on the 57 SX; 40/80MB on the 40 SX and 35 SX. Memory is upgradable to 16MB with 4MB standard on the 57 SX, 2MB on the 35 SX and 40 SX. The 40 SX and 57 SX each have five expansion slots and four DASD bays; three slots and two bays on the 35 SX. A medialess 35 SX LAN station model is also available with a Token-Ring Adapter standard.

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T-1 and T-3 multiplexers (continued from page 41)

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; Inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum non-redundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatibility (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Fujitsu America, Inc. **Richardson, Texas** **(214) 690-6000**	DMIX Intelligent Network Nodal Processor (T-3, bit)	Circuit; frame relay support not planned	16 T-1; 432 9.6K bit/sec, 384 56K bit/sec circuits per node supported	RS-232, RS-449, D4/DS1, V.35, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, multipoint, ring, drop-and-insert, bypass; T-1/DS1	16; 2	Asynchronous: 444 at 2.4K bit/sec; synchronous: 444 at 2.4K bit/sec	392; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 300-9.6K bit/sec, 64K-1.536M bit/sec; synchronous: 2,400-19.2K, 48K-1.536M bit/sec	DS0, subrate, B8ZS, DACS	Optional DMIX management system allows configuration management, problem management and network administration functions; standard interfaces:: T-1 line, international high-rate digital line, V.24/V.28; optional interfaces: V.35, RS-449, digital voice interface, analog voice interface	Standard: dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$30,000 to $200,000/1 year
Gandalf Data, Inc. **Wheeling, Ill.** **(708) 541-8803**	GLM 528 E (T-1, bit)	Circuit; frame relay support not planned	128 T-1; 128 9.6K bit/sec, 0-56K bit/sec	DS1; data	Point-to-point, multipoint; T-1/DS1, twisted-pair	5; 1	Asynchronous: 128; synchronous: 128	0; NA	Asynchronous: up to 19.2K bit/sec, synchronous: up to 64K bit/sec	Proprietary muxing scheme	None; none	Optional: redundant power supply	$3,000 for 32-channel unit/1 year
General DataComm, Inc. **Middlebury, Conn.** **(800) 777-4005**	MEGAMUX TMS, MEGAMUX Plus, MINIMUX (T-1, bit and byte)	Circuit; frame relay support planned	128 T-1; 128 9.6K bit/sec, 27 56K bit/sec	RS-233, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic	128; 32	Asynchronous: 512K bit/sec; synchronous: 512K bit/sec; isochronous: 512K bit/sec	512; PCM: 64K bit/sec, ADPCM: 16K, 24K and 32K bit/sec, CVSD: 19.2K, 24K and 32K bit/sec; proprietary: 2.4K, 4.8K and 9.6K bit/sec	Asynchronous: 75-19.2K bit/sec, synchronous: 1,200-1.544M bit/sec; isochronous: 1,200-64K bit/sec	Proprietary muxing scheme; DS0, B8ZS, DACS	Aggregate and channel loop-backs, integral BERT; Optional interfaces: AT&T UNMA, IBM NetView	Standard: E-1 circuits, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$4,000-$7,500/1 year
Granger Telletra **San Jose, Calif.** **(408) 944-9190**	DTI 45 Drop and Insert Multiplexer (T-3, byte)	NA; frame relay support not planned	14 T-1, 2 T-3; 9.6K and 56K bit/sec circuit support NA	RS-422, D4/DS1, E&M 1, 2, 3, 4, 5; voice, data	Multipoint, drop-and-insert; T-1/DS1, DS3, DSX3, microwave, fiber-optic, twisted-pair	28; 2	Asynchronous: 7; synchronous: 0	14; PCM: 1.544M bit/sec	Asynchronous: 56K, 64K bit/sec; synchronous: NA	Nonproprietary muxing scheme (M13); DS0, B8ZS; DACS	Local programming, alarm monitoring and maintenance; remote management via PC with DOS and Windows 3.0; none	Standard: user-programmable features; optional: redundant power supply, primary alternate route selection, supervisory port	$6,430-$37,540/1 year
IBM **Armonk, N.Y.** **Contact local IBM representative**	IBM 9736 (2) (T-1, byte)	Circuit; frame relay support planned	15 T-1, 127 9.6K bit/sec, 26 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1-5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	250; 15	Asynchronous: 84; synchronous: 84	335; PCM: 64K bit/sec, ADPCM: 24K and 32K bit/sec	Asynchronous: 75-19.2K bit/sec; synchronous: 1,200-1.344M bit/sec	Proprietary muxing scheme; DS0, B8ZS, DACS	Network control, internal self-tests, real-time monitoring, local and remote loop-backs, event/alarm logs; standard interface: RS-232 operator interface; optional interface: NetView	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$16,000-$52,000 depending on configuration/3 months
	IBM 9738-090 (2) (T-1, T-3, byte)	Circuit; frame relay support planned	96 T-1, 4 T-3, 127 9.6K bit/sec, 26 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1-5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, DS3, microwave, satellite, fiber-optic, twisted-pair, coaxial	250; 96 T-1, 4 T-3	Asynchronous: 328; synchronous: 328	2,000; PCM: 64K bit/sec, ADPCM: 24K and 32K bit/sec	Asynchronous: 75-19.2K bit/sec; synchronous: 1,200-2.048M bit/sec	Proprietary, DS0, B8ZS, DACS	Network control, internal self-tests, real-time monitoring, local and remote loop-backs, event/alarm logs; standard: RS-232 operator interface; optional: NetView	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; redundant power supply	$90,000-$250,000 depending on configuration/3 months

ADPCM = Adaptive differential pulse code modulation
B8ZS = Bipolar eight zero code substitution
BERT = Bit error rate tester
CEPT = Conference Europeenne des Postes et Telecommunications
CMIP = Common Management Information Protocol
CMIS = Common Management Information Services
CSU = Channel service unit
CVSD = Continuously variable slope delta
DACS = Digital access and cross-connect system

DDS = Digital data service
HSSI = High-speed serial interface
MIL = U.S. military specification
NA = Not applicable
PCM = Pulse code modulation
SNMP = Simple Network Management Protocol
SONET = Synchronous Optical Network
UNMA = AT&T's Unified Network Management Architecture
VAPC = Vector adaptive predictive coding

FOOTNOTES:

(1) "Proprietary" indicates that the vendor uses a proprietary multiplexing scheme; the other answers in this category list the various areas of public network standards with which the vendor's product is compatible.
(2) This product is not manufactured by the firm listed.
(3) This product is based on standard RBHC D4 mechanics. As such, multiple line interfaces from several vendors are compatible.
(4) Any mix of T-3 and T-1 circuits can be configured up to a maximum of 360 T-1 equivalents. The system conforms to applicable DS3 and DS1 standards.
(5) The INpath is an access multiplexer optimized for carriers/service providers (interexchange carriers, local exchange carriers, alternate access carriers).

This chart includes a representative selection of T-1 and T-3 mux vendors. Vendors not included may offer a full range of competitive products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

T-1 and T-3 multiplexers (continued on page 46)

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum non-redundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatibility (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Infotron Systems Corp. **Cherry Hill, N.J.** **(609) 751-4255**	NX Series - NX4600, NX3200, NX3000, NX3040, NX3020 (T-1, byte)	Circuit; frame relay support planned	20 T-1; 128 9.6K bit/sec, 24 54K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, AT&T 301/303, MIL-188, E&M 1, 2, 4, 5; voice, data, image, video, fax	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass, mesh network; T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	More than 1,000; 99	Asynchronous: 4,000 at approximately 9.6K bit/sec; synchronous: 4,000 at approximately 9.6K bit/sec	1,000; PCM, ADPCM, proprietary, other: 21.3K bit/sec via CCITT algorithm	Asynchronous: 50-19.2K bit/sec; synchronous: 50-1.984M bit/sec	Proprietary and non-proprietary muxing schemes; DS0, B8ZS, DACS	Channel loop, channel trace, channel monitor, force connect/disconnect, channel interface control signal toggle; standard interfaces: Unix-based Hewlett-Packard Co. workstation, optional interfaces: UNMA (AT&T Accumaster Integrator), NetView/PC (IBM NetView)	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	$11,600 to $22,000/1 year
	Streamline 45 (T-3, bit)	Circuit; frame relay support planned	NA; 2 T-3; 128 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, AT&T 301/303, MIL-188, E&M 1, 2, 4, 5; voice, data, image, video, fax	Point-to-point, ring, drop-and-insert, bypass; T-1/DS1, DS3, microwave, satellite, fiber-optic, twisted-pair	16; 2	NA	NA; NA	NA (interfaces that operate below T-1/E-1 data rates use the NX series as the input devices)	Proprietary muxing scheme	Alarm reporting/ monitoring: operation alarms refer to transmission problems and data base alarms refer to configuration/ system problems; standard interface: Streamline network management system	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	Starts at $16,700/1 year
Larse Corp. **Santa Clara, Calif.** **(408) 988-6600**	Split-T, FT1 Access Mux (T-1, byte)	Circuit; frame relay support not planned	1 T-1; 24 56K bit/sec	RS-422, RS-449, D4/DS1, V.35, E1A530; voice, data, image, video	Point-to-point, multipoint, drop-and-insert; T-1/DS1	2+; 1	Asynchronous: NA; synchronous: 2	1 (DS1); PCM	Asynchronous: NA; synchronous: 56K-1.536M bit/sec	DS0, B8ZS, DACS	RS-232 support, AT&T 54016 and ANSI T1.403, loop-back, T-1 or fractional T-1 test patterns, alarm dial-out, performance thresholds; standard: Codex 9800	Standard: supervisory port	$3,500-$4,400/2 years
Micom Communications Corp. **Simi Valley, Calif.** **(800) 642-6687**	INSTA-TRUNK 480 (T-1, bit)	Circuit; frame relay support not planned	1 T-1; 128 9.6K bit/sec, 32 56K bit/sec	RS-232; data	Point-to-point, multipoint; T-1/DS1, microwave, twisted-pair	5; 1	Asynchronous: 128; synchronous: 0	Voice and synchronous data channels are supported across T-1 links when using model M481H INSTA-TRUNK multiplexer installed in Micom CommServer	Asynchronous: 19.2K bit/sec; synchronous: NA	Proprietary muxing scheme; DS0	Synchronous loss and bipolar violation alarms (local and remote), power loss alarm; standard interfaces: major alarm relay contacts, minor alarm relay contacts	Optional: redundant power supply	$2,000-$16,500 per node/3 years
Netrix Corp. **Herndon, Va.** **(703) 742-6000**	#1-ISS (T-1, bit)	Circuit, packet; currently supports frame relay	32 T-1; 120 9.6K bit/sec, 24 56K bit/sec (more if multiple nodes are clustered)	RS-232, D4/DS1, V.11, V.35; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass, mesh; T-1/DS1	4,000; 32 T-1, more if lower speed (subrate)	Asynchronous: 1,200, synchronous: 1,200	Supported through attachment of external device; NA	Asynchronous: up to 19.2K bit/sec; synchronous: up to 2.046M bit/sec (both in increments of 8K bit/sec)	Proprietary muxing scheme; DS0, B8ZS	Integrated graphics-based network management for configuration, monitoring, control and reporting; no interfaces available	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, tandem switching, primary alternate route selection, supervisory port; optional: redundant power supply, user-programmable features	Starts at $15,000/90 days

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BERT = Bit error rate tester
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CMIP = Common Management Information Protocol
CMIS = Common Management Information Services
CSU = Channel service unit
CVSD = Continuously variable slope delta
DACS = Digital access and cross-connect system

DDS = Digital data service
HSSI = High-speed serial interface
MIL = U.S. military specification
NA = Not applicable
PCM = Pulse code modulation
SNMP = Simple Network Management Protocol
SONET = Synchronous Optical Network
UNMA = AT&T's Unified Network Management Architecture
VAPC = Vector adaptive predictive coding

FOOTNOTES:

(1) "Proprietary" indicates that the vendor uses a proprietary multiplexing scheme; the other answers in this category list the various areas of public network standards with which the vendor's product is compatible.
(2) This product is not manufactured by the firm listed.
(3) This product is based on standard RBHC D4 mechanics. As such, multiple line interfaces from several vendors are compatible.
(4) Any mix of T-3 and T-1 circuits can be configured up to a maximum of 360 T-1 equivalents. The system conforms to applicable DS3 and DS1 standards.
(5) The INpath is an access multiplexer optimized for carriers/service providers (interexchange carriers, local exchange carriers, alternate access carriers).

This chart includes a representative selection of T-1 and T-3 mux vendors. Vendors not included may offer a full range of competitive products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

T-1 and T-3 multiplexers (continued from page 45)

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum non-redundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatibility (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Network Equipment Technologies, Inc. Redwood City, Calif. (800) 234-4638	IDNX/20 Transmission Resource Manager (T-1, E-1, byte)	Circuit, packet; frame relay support planned	15 T-1, 127 9.6K bit/sec, 26 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1-5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass	250; 15	Asynchronous: 84; synchronous: 84	336; PCM: 64K bit/sec, ADPCM: 24K and 32K bit/sec, VAPC: 8K and 16K bit/sec	Asynchronous: 7.5K, 19.2K bit/sec; synchronous: 1.2K, 1.344M bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	NET-provided system on Sun platform; standard interface: RS-232 operator interface; optional interfaces: NetView, Accumaster	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$16,000-$52,000, depending on configuration/3 months
	IDNX/90 Transmission Resource Manager (T-1, T-3, E-1, byte)	Circuit and packet; frame relay support planned	96 T-1, 4 T-3, 127 9.6K bit/sec, 26 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1-5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass	250; 96 T-1s	Asynchronous: 328; synchronous: 328	2,000, PCM, ADPCM, VAPC	Asynchronous: 75-19.2K bit/sec; synchronous: 1,200-2.048M bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	Network control real-time monitoring, internal self-tests, local and remote loop-back, event/alarm logs; standard interface: RS-232 operator interface; optional interface: NetView, Accumaster	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, tandem switching, primary alternate route selection, user-programmable features, supervisory port, redundant power supply	$80,200-$250,000, depending on configuration/90 days on hardware, 1 year on software
Newbridge Networks, Inc. Herndon, Va. (703) 834-3600	3645 Mainstreet High-capacity Bandwidth Manager (T-1, T-3, byte)	Circuit; frame relay support planned	256 T-1, 8 T-3; 144 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.11, V.35, MIL-188, E&M 1, 2, 3, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, DS3, microwave, satellite, fiber-optic, twisted-pair	More than 1,000; 256	Asynchronous: 12,228; synchronous: 12,228 (up to 19.2K bit/sec), 3,072 (all supported speeds)	1,536; PCM: 64K bit/sec, ADPCM: 32K bit/sec, proprietary: 8K and 16K bit/sec	Asynchronous: 150-38.4K bit/sec; synchronous: 1,200-2.048M bit/sec	DS0, subrate, B8ZS, DACS	With optional 4602 Network Manager, supports: trouble tickets, performance statistics, automatic rerouting, automatic self-test, automatic fault isolation and analysis, automatic path setup; optional interfaces: NetView, Accumaster; other: SNMP	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	$20,000-$300,000/ 14 months
Northern Telecom, Inc. Norcross, Ga. (404) 840-5000	DE-4E SMART (3) (T-1, byte)	Circuit; frame relay throughput supported	1 T-1, 24 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, E&M 1, 2, 3; voice, data, image, video	Point-to-point, tandem, bypass, switched services (voice and data); T-1/DS1, fiber-optic, twisted-pair	255, 1	Asynchronous: up to 24; synchronous: up to 24	24; PCM: 64K bit/sec	Asynchronous: up to 19.2K bit/sec; synchronous: up to 64K bit/sec	DS0, subrate, B8ZS, DACS	SMART network manager for up to 255 D1 groups, up to 32 sites, performance monitoring DS1 and DS0 level, fully software programmable (both voice and data), software downloadable; standard interfaces: X.25, others supported: RS-485, RS-232	Standard: tandem switching, user-programmable features, supervisory port; optional: dynamic bandwidth allocation, sub-DS0 bandwidth allocation, redundant power supply	$5,000-$8,000/1 year
Pulse Communications, Inc. A subsidiary of Hubbel, Inc. Herndon, Va. (703) 471-2900	T-1 Business-Bank (T-1, byte)	Circuit; frame relay support not planned	48 T-1; 120 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, E&M 1, 2, 3; voice, data, image, video (compressed)	Point-to-point, tandem; T-1/DS1, microwave, satellite, fiber-optic, fractional T-1	2; 2	Asynchronous: 480; synchronous: 480	48; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 75 bit/sec-57.6K bit/sec; synchronous: 2,400 bit/sec-1.536M bit/sec	(3); DS0, subrate, B8ZS, DACS	Printed reports, Microsoft Corp. Windows-based access to up to 124 D1 groups and 2,976 DS0 ports; standard interfaces: ANSI T1.403-1989, RS-485, RS-232 dial-up or dedicated	Optional: sub-DS0 bandwidth allocation, redundant power supply, tandem switching, user-programmable features, supervisory port	$2,950-$8,000/5 years
Racal-Milgo Sunrise, Fla. (800) 722-2555	Omnimux Series (T-1, nibble, bit, byte)	Circuit; frame relay support planned	4-768 T-1; 160 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic, twisted pair	256; 18	Asynchronous: 768; synchronous: 768	768; PCM: 64K bit/sec, ADPCM: 32K bit/sec, CVSD: 16K, 32K, 64K bit/sec, proprietary: 19.2K bit/sec	Asynchronous: 1,200-38.4K bit/sec; synchronous: 1,200-1.536M bit/sec	Proprietary muxing scheme for sub-rates (not for T-1), DS0, B8ZS, DACS	Omnimux Network Manager, CMS 400, remote and local loop-back, BERT, test tones; standard Interfaces: ASCII, asynchronous VT-220, Racal-Milgo T7, Racal-Milgo MDS II; optional interfaces: NetView, SNMP, CMIP/CMIS	Standard: dynamic bandwidth allocaton, sub-DS0 bandwidth allocation, channel prioritization, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	$4,500-$135,000/1 year
RAD Data Communications, Ltd. Rochelle Park, N.J. (201) 587-8822	Megaplex 2000 T-1 (T-1, byte)	Circuit; frame relay support planned	2 T-1; 70 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.11, V.35, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, drop-and-insert; T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	3; 2	Asynchronous: 70; synchronous: 70	55; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 19.2; synchronous: 1.536M bit/sec	DS0, subrate, B8ZS, DACS	PC-based management system included; none	Standard: channel prioritization, redundant power supply, primary alternate route selection, user-programmable features, supervisory port; optional: E-1, sub-DS0 bandwidth allocation	$4,400-$12,000/1 year

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BERT = Bit error rate tester
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CMIP = Common Management Information Protocol
CMIS = Common Management Information Services
CSU = Channel service unit
CVSD = Continuously variable slope delta
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FOOTNOTES:

(1) "Proprietary" indicates that the vendor uses a proprietary multiplexing scheme; the other answers in this category list the various areas of public network standards with which the vendor's product is compatible.
(2) This product is not manufactured by the firm listed.
(3) This product is based on standard RBHC D4 mechanics. As such, multiple line interfaces from several vendors are compatible.
(4) Any mix of T-3 and T-1 circuits can be configured up to a maximum of 360 T-1 equivalents. The system conforms to applicable DS3 and DS1 standards.
(5) The INpath is an access multiplexer optimized for carriers/service providers (interexchange carriers, local exchange carriers, alternate access carriers).

This chart includes a representative selection of T-1 and T-3 mux vendors. Vendors not included may offer a full range of competitive products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

T-1 and T-3 multiplexers (continued on page 48)

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum non-redundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatibility (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Republic Telcom Systems Corp. Boulder, Colo. (303) 530-8600	RLX-D Series Multiplexing System (T-1, byte)	Circuit, packet; frame relay support planned	24 T-1 (12 per chassis; multiple chassis available); 4 9.6K bit/sec, 16 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.11, V.35, E&M 1, 2, 5; voice, data, image, video	Point-to-point, multipoint, drop-and-insert; T-1/DS1, microwave, satellite, other: E-1	16; 16	Asynchronous: 0; synchronous: 44	48; PCM: 64K bit/sec, proprietary: 64K bit/sec	Asynchronous: NA; synchronous: 1,200-1.024K bit/sec	Proprietary and non-proprietary muxing schemes; subrate planned, B8ZS, DACS	Remote and local configurations of all nodes, Network Control System stores all parameters, time-of-day configuration (24 hours, 7 days), local and remote loop-backs; standard interface: Republic Telcom's Network Control System, optional interface: SNMP, Accumaster	Standard: dynamic bandwidth allocation, channel prioritization, user-programmable features, supervisory port; optional: E-1, sub-DS0 bandwidth allocation, redundant power supply, tandem switching, primary alternate route selection	$15,000-$50,000 (available third-quarter 1991)/1 year
Scitec Communication Systems, Ltd. Middletown, R.I. (401) 849-4353	Maxima (T-1, byte)	Circuit, frame relay support planned	16 T-1; 145 9.6K bit/sec, 27 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.10, V.11, V.35, E&M 1, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	64; 8	Asynchronous: 128; synchronous: 512	154; PCM: 64K bit/sec, ADPCM: 16K, 32K, 64K bit/sec	Asynchronous: up to 19.2K bit/sec; synchronous: 9.6K-2.048K bit/sec	Proprietary muxing scheme; DS0, B8ZS	None; optional: NetView	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply, tandem switching	$15,000-$250,000/1 year
Stratacom, Inc. Campbell, Calif. (408) 370-2333	IPX Fast Packet Networking System (T-1, T-3, fast packet)	Fast packet; currently supports frame relay	96 T-1, 8 T-3; 600 9.6K bit/sec, 80 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.11, V.35, MIL-188, E&M 2, 4; voice, data, image, video, frame relay	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, DS3, microwave, satellite, twisted-pair	256; 96	Asynchronous: 192; synchronous: 96	96; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 2,400-56K bit/sec; synchronous: 56K-1.544M bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	Self-test, loop-back; standard interface: CMIP	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, redundant power supply, tandem switching, primary alternate route selection, user-programmable features, supervisory port	$30,000-$150,000/ 90 days
Telco Systems Network Access Corp. Fremont, Calif. (800) 776-8832	Route-24 (T-1, byte)	Circuit; frame relay support planned	1 T-1; 96 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.35, E&M 1, 2; voice, data, image, video	Point-to-point, multipoint, drop-and-insert, point-to-backbone, point-to-network; T-1/DS1, twisted-pair	Unlimited; 1 per T-1	Asynchronous: 72 per T-1; synchronous: 96 per T-1	24 per T-1; PCM: 1.544M bit/sec	Asynchronous: 1.2K-19.2K bit/sec; synchronous: 2,400 bit/sec-1.536M bit/sec	DS0, subrate, B8ZS, DACS	Monitoring and control via local asynchronous terminal or Telco Systems' MuxView network management system; none	Standard: dynamic bandwidth allocation, tandem switching, user-programmable features, supervisory port	$6,000-$39,000/5 years
Telematics International, Inc. Herndon, Va. (305) 772-3070	DX Digital Wideband Exchange (T-1, bit)	Circuit, frame relay support planned	16 T-1; 160 9.6K bit/sec, 27 56K bit/sec	RS-232, RS-422, RS-423, RS-449, D4/DS1, V.10, V.11, V.35, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite, fiber-optic	128; 8	Asynchronous: 264; synchronous: 508	508; PCM: 64K bit/sec, ADPCM: 16K, 24K, 32 bit/sec	Asynchronous: 50-38.4K bit/sec; synchronous: 1,200-2M bit/sec	Proprietary muxing scheme; DS0, B8ZS, DACS	Management interfaces included for Sun Workstation, NetView PC, ASCII console	Standard: E-1, dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, primary alternate route selection, user-programmable features, supervisory port; optional: redundant power supply	$10,000-$150,000/6 months
Tellabs, Inc. Lisle, Ill. (708) 969-8800	Crossnet Multiplexing System (T-1, bit and byte)	Circuit; frame relay support planned	1-16 T-1; 128 9.6K bit/sec, 27 clear-channel 56K bit/sec, 24 non-clear-channel 56K bit/sec	RS-232, RS-422, RS-449, D4/DS1, V.11, V.35, MIL-188, E&M 1, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass; T-1/DS1, microwave, satellite	250; 16	Asynchronous: 128; synchronous: 128	48; PCM: 64K bit/sec, ADPCM: 32K bit/sec, proprietary: 34K bit/sec	Asynchronous: 38.4K bit/sec; synchronous: 1,200-1.984M bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	Integrated reporting, logging, diagnostics and configuration from ASCII terminal or optional Tellabs NMCS 2500 Network Manager; optional interfaces: NetView PC software through IBM, other: machine-to-machine based on Tellabs Datagram Command Language	Standard: sub-DS0 bandwidth allocation, channel prioritization, primary alternate route selection, user-programmable features, supervisory port; optional: E-1, redundant power supply, tandem switching	$7,500-$35,000/2 years
Timeplex, Inc. Woodcliff Lake, N.J. (800) 669-2298	LINK + Integrated Connectivity Systems (T-1, byte)	Circuit; frame relay support planned	48 T-1; 153 9.6K bit/sec, 27 56K bit/sec	RS-232, RS-422, RS-423, D4/DS1, V.10, V.11, V.35, MIL-188, E&M 1, 2, 3, 4, 5; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert, bypass	252; 7	Asynchronous: 208; synchronous: 208	248; PCM: G4K bit/sec, ADPCM: 32K bit/sec, CVSD: 16K-64K bit/sec, proprietary: 8K and 16K bit/sec	Asynchronous: 45.4 bit/sec-19.2K bit/sec; synchronous: 50 bit/sec-1.984M bit/sec	Proprietary muxing scheme; DS0, subrate, B8ZS, DACS	Diagnostics via ASCII terminal or Time/View 2000 Network Management System (Time/View 2000 Integrated Network Management System sold separately); optional interfaces: Accumaster, NetView, Timeplex TX 3/SuperHub	Standard: E-1, dynamic bandwidth allocation, channel prioritization, redundant power supply, primary alternate route selection, user-programmable features, supervisory port; optional: sub-DS0 bandwidth allocation, tandem switching	$7,000-$130,000/1 year

ADPCM = Adaptive differential pulse code modulation
B8ZS = Bipolar eight zero code substitution
BERT = Bit error rate tester
CEPT = Conference Europeenne des Postes et Telecommunications
CMIP = Common Management Information Protocol
CMIS = Common Management Information Services
CSU = Channel service unit
CVSD = Continuously variable slope delta
DACS = Digital access and cross-connect system

DDS = Digital data service
HSSI = High-speed serial interface
MIL = U.S. military specification
NA = Not applicable
PCM = Pulse code modulation
SNMP = Simple Network Management Protocol
SONET = Synchronous Optical Network
UNMA = AT&T's Unified Network Management Architecture
VAPC = Vector adaptive predictive coding

FOOTNOTES:

(1) "Proprietary" indicates that the vendor uses a proprietary multiplexing scheme; the other answers in this category list the various areas of public network standards with which the vendor's product is compatible.
(2) This product is not manufactured by the firm listed.
(3) This product is based on standard RBHC D4 mechanics. As such, multiple line interfaces from several vendors are compatible.
(4) Any mix of T-3 and T-1 circuits can be configured up to a maximum of 360 T-1 equivalents. The system conforms to applicable DS3 and DS1 standards.
(5) The INpath is an access multiplexer optimized for carriers/service providers (interexchange carriers, local exchange carriers, alternate access carriers).

This chart includes a representative selection of T-1 and T-3 mux vendors. Vendors not included may offer a full range of competitive products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

T-1 and T-3 multiplexers (continued from page 47)

Company	Product (type)	Type of switching; frame relay support	T-1 or T-3 circuits supported; 9.6K and 56K circuits supported per T-1	Interfaces supported; inputs supported	Configurations supported; transmission facilities supported	Maximum nodes per net; maximum nonredundant links per node	Number of data ports per node	Number of voice ports per node; voice quantization schemes	Transmission speeds supported	Public network compatibility (1)	Management and diagnostics included; management interfaces supported	Standard and optional features	Price range/ warranty period
Timeplex	TX3/SuperHub (T-3, byte)	Circuit, frame relay support not planned	196 T-1, 10 T-3 (4); NA	D4/DS1, DSX3; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert; T-1/DS1, DS3, microwave, satellite, fiber-optic	200; 10 DS3; 196 DS1	NA	NA	NA	B8ZS, DACS	TX3/SuperHub Element Management System; standard: Time/View 2000 Network Management System (planned), other: Accumaster, NetView will be supported via Time/View 2000	Standard: tandem switching, user-programmable features, supervisory port; optional: redundant power supply, primary alternate route selection	$30,000-$200,000/1 year
Telecommunications Technology, Inc. A unit of General Signal Co. Milpitas, Calif. (408) 945-1700	INpath 1000 (5) (T-1, byte)	Circuit; frame relay support not planned	2 T-1; up to 120 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, D4/DS1, V.35, E&M 1 and 2; voice, data, image, video	Point-to-point, multipoint, ring, tandem, drop-and-insert; T-1/DS1	NA (INpath is an access mux); 2 nonredundant links per unit	Asynchronous: 24; synchronous: 24	24 voice ports per unit; PCM: 64L bit/sec	Asynchronous: 1.2K-56K bit/sec; synchronous: 2,400-1.5M bit/sec	DS0, subrate, B8ZS, DACS	DS1 loop-back, individual channel loop-back for voice and data, short/open test for 2-wire, individual channel card self-diagnostics, milliwatt test for individual CSUs; interfaces to other management systems through ASCII message sets	Standard: redundant power supply, tandem switching, user-programmable features, supervisory port; optional: dynamic bandwidth allocation, primary alternate route selection	$8,000-$27,000/1 year
TyLink Corp. Norton, Mass. (508) 285-0033	Open Network Concentrator 100 (T-1, byte)	Circuit; frame relay support planned	1 T-1; 144 9.6K bit/sec, 24 56K bit/sec	RS-232, RS-422, RS-433, RS-449, D4/DS1, E&M 1, 4; voice, data, image, video	Point-to-point, multipoint, point-to-network; T-1/DS1, microwave, satellite, fiber-optic, twisted-pair	Unlimited with DACS switching; 1 plus fallback	Asynchronous: 144; synchronous: 144	28; PCM: 64K bit/sec, ADPCM: 32K bit/sec	Asynchronous: 300 bit/sec-38.4K bit/sec; synchronous: 2.400K-1.536M bit/sec	DS0, subrate, B8ZS, DACS	ASCII terminal configuration, monitor and alarms; none	Standard (dependent on configuration): dynamic bandwidth allocation, sub-DS0 bandwidth allocation, channel prioritization, redundant power supply, primary alternate route selection, user-programmable features, supervisory port	$5,000-$25,000/1 year

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This chart includes a representative selection of T-1 and T-3 mux vendors. Vendors not included may offer a full range of competitive products.

SOURCE: TELECHOICE, INC., MONTCLAIR, N.J.

(continued from page 38)

order to access necessary network traffic information and alarms, and act on them when necessary.

Such functionality should be available through a single console on the multiplexer or through a management interface from the multiplexer to a computer or terminal.

Some of the network management functions that users should request include the regular update of network data bases with traffic and hardware information; network reconfiguration; alarm or event recording and display; and loopback tests for every piece of hardware connected to the network.

Also look for fault isolation and rerouting capabilities. Does the multiplexer have a built-in bit error rate tester? How fast does the multiplexer recover applications when the network goes down? How is clocking restored, and from what sources?

Interfaces to an external network management system are another important consideration. Many users are looking to link their various net elements, including multiplexers, into an integrated network management system that will help them monitor and control their entire network.

Some multiplexer vendors, such as Codex Corp., Newbridge Networks, Inc. and Timeplex, offer a broad array of network management software of their own that will also work with larger network management systems, including AT&T's Accumaster Integrator, Digital Equipment Corp.'s DEC Management Control Center and IBM's NetView.

ISDN PRI support is also a relevant factor. Users planning to take advantage of ISDN in the future should prepare now by buying multiplexers that support it. Timeplex currently supports ISDN PRI. All those listed in our chart say they plan to support ISDN PRI.

In the future, customer premises multiplexers that support the new multiplexing technology Synchronous Optical Network (SONET), and the circuit speeds of hundreds of megabits per second that go along with it, may well be necessary. But SONET services are unlikely to be widely available from carriers until the late 1990s. Some vendors, such as General DataComm, Inc., view T-3 as a step forward on the SONET path.

While T-1 is entrenched, vendors are now turning their attention to building T-3 support into their products. However, T-3, the equivalent of 28 T-1 channels, is a tremendous amount of bandwidth. Multiplexer vendors estimate that only about 5% of their customers currently need or use T-3 circuits.

> Users planning to take advantage of ISDN in the future should prepare now.
>
> ▲▲▲

These vendors, however, are willing to compete for users' business. While only 11 of the 38 vendors surveyed now offer a T-3 multiplexer, most plan to do so within the next 12 to 18 months.

Until recently, most T-3 multiplexers were little more than T-3 channel banks or nonintelligent M13 multiplexers. This is changing slowly as more users enter the T-3 market and vendors build more and greater functionality and intelligence into their multiplexers.

Interestingly, many of the carriers offering T-3 lines do not switch them in their points of presence as T-3 circuits. Due to a lack of T-3 digital access and cross-connect systems (DACS), carriers have been demultiplexing the T-3 circuit into 28 T-1 circuits, switching these T-1 lines through a T-1 DACS and reassembling them into a T-3 line.

This approach is changing, however, as more vendors are making T-3 DACS equipment. Users may wish to ask carriers if their T-3 services are handled in this way and then examine their applications to see if such switching would be detrimental.

Based upon information from the leading interexchange carriers, it is estimated that the monthly lease costs for about 10 T-1 lines can justify the monthly lease cost for one T-3 line.

AT&T, for example, currently charges $40,538 per month for a 250-mile T-3 line and $4,027 for a 250-mile T-1 circuit. This does not include differences in one-time installation costs or other nonrecurring charges, nor does it take into account any promotions or volume discounts available for either service. Very few users, however, can currently justify 10 T-1 lines.

(continued on page 61)

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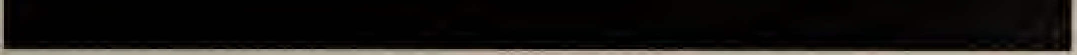

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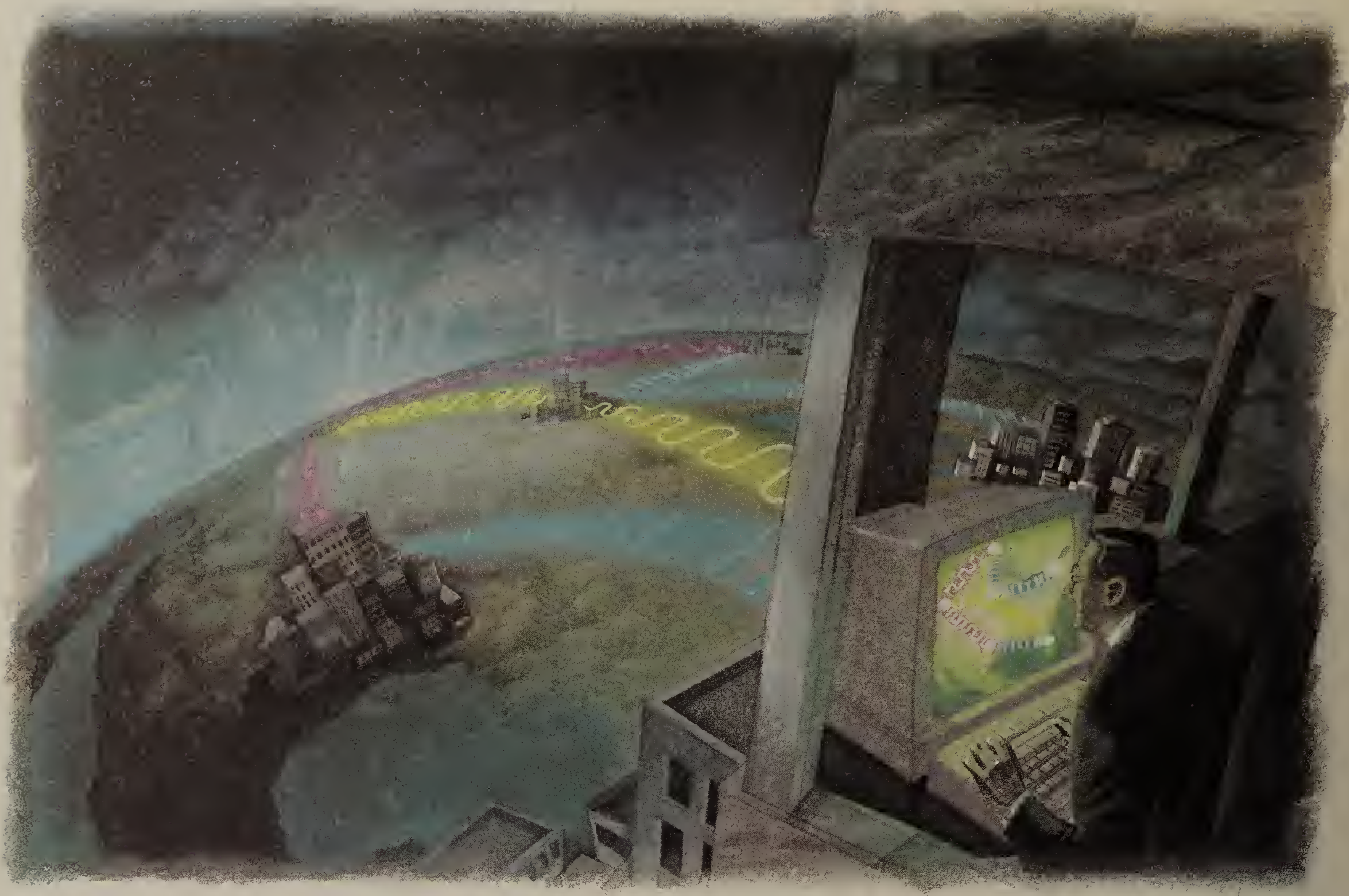

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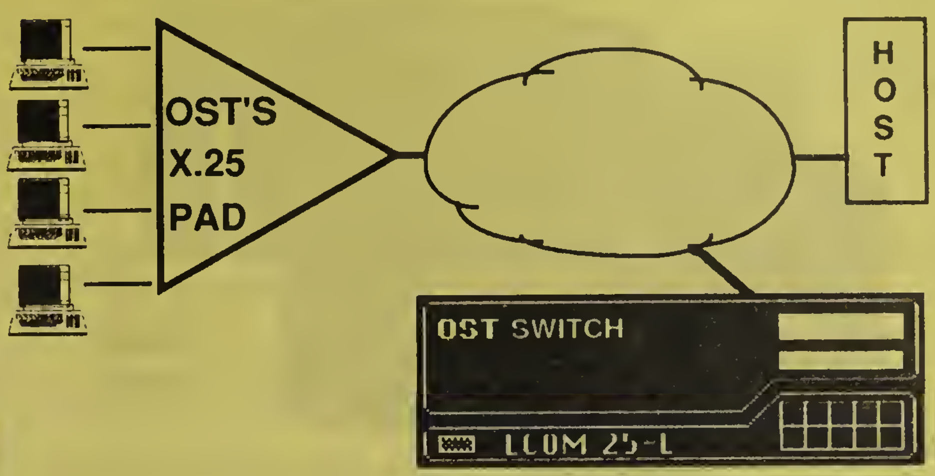

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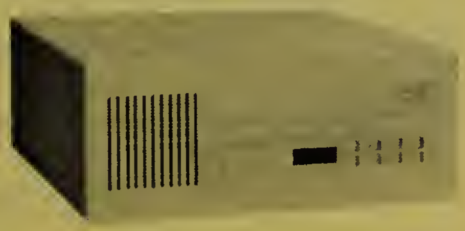

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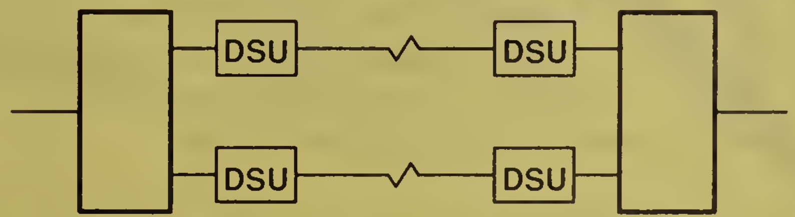

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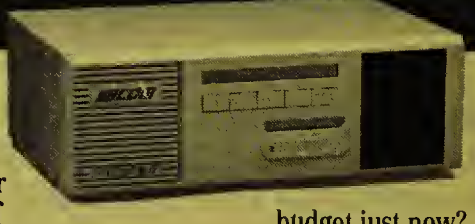

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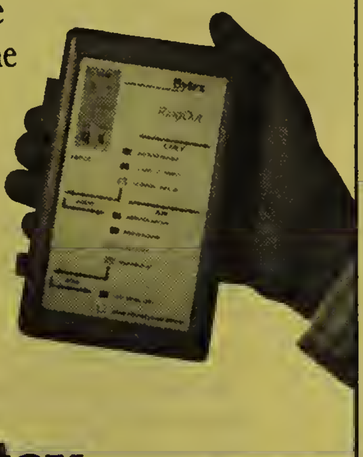

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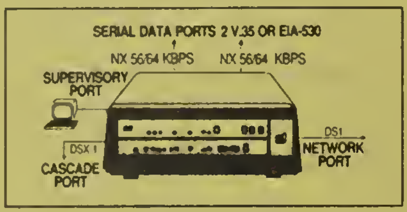

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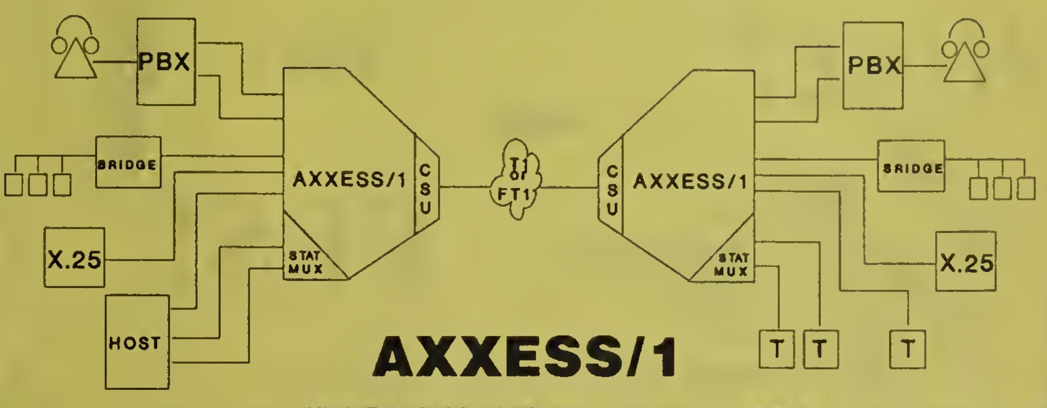

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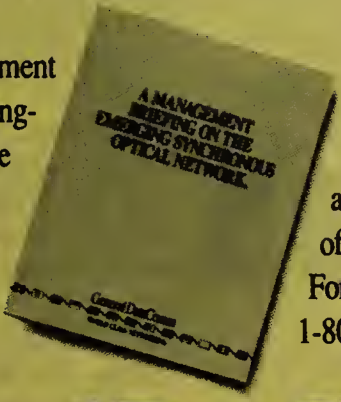
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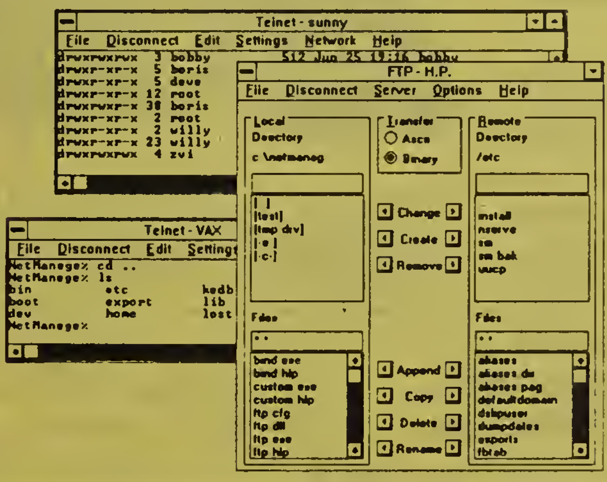
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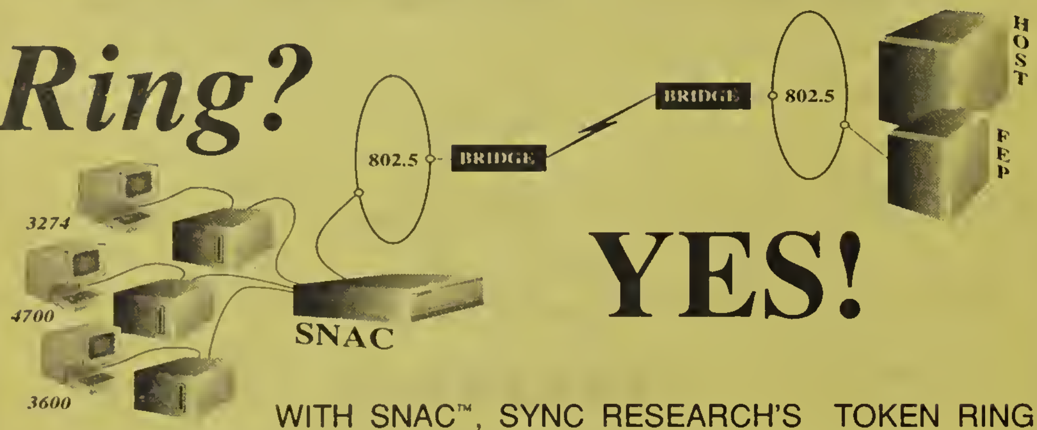

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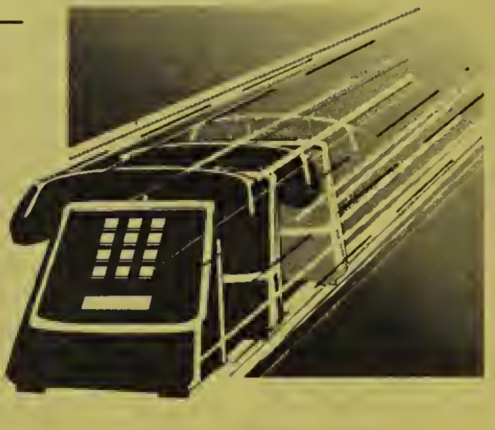

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Datacom Buyer's Guide

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Besides the issues discussed above, users in the market for a T-1 or T-3 multiplexer should consider the following factors:

■ **Voice vs. data.** Some multiplexers are more suited for one than the other. Typically, packet-switching multiplexers are better for the bursty needs of local-area network-to-LAN or LAN-to-wide-area network transmission and other bursty data applications.

On the other hand, circuit-switched multiplexers, which make up the bulk of offerings, tend to be more adept at handling continuous-stream information, such as voice calls, which are more sensitive to a switched environment.

Voice compatibility may be a major or minor issue, depending upon your network needs and applications. If voice is a high priority, inquire as to the quality of the voice signal through the multiplexer in question. Ask about the switch delay, or latency — the time it takes for the multiplexer to receive and retransmit signals. Delays of several milliseconds may be too much, depending upon your network and the application.

High levels of attenuation on the PBX side mean poor voice signal quality.

▲▲▲

This is especially important in larger networks with several multiplexers handling signals in tandem; the more tandem switches, the greater the accumulated delay and the worse the signal may become. Users experiencing such problems may need to buy echo-cancelling equipment, either packaged in the multiplexer or separately, to eliminate signal echo problems caused by tandem switching.

Other voice issues to evaluate include the voice compression scheme used and the flexibility in attenuation between the multiplexer and any connected private branch exchange. High levels of attenuation on the PBX side mean poor voice signal quality. Your multiplexer should be able to adjust to this attenuation and maintain good signal quality.

■ **Voice compression.** There are three major methods used to digitize voice signals: pulse code modulation (PCM), adaptive differential pulse code modulation (ADPCM) and continuously variable slope delta (CVSD) modulation.

One of the basic technologies behind T-1 transmission, PCM is basically a coded set of digital pulses representing voice signals in a 64K bit/sec channel. ADPCM reduces the bit rate needed to carry a voice signal by one-half, while CVSD reduces it to as little as one-quarter. Therefore, users with large voice requirements may wish to investigate CVSD.

All of the vendors listed support either PCM, ADPCM or both. CVSD is supported by only four of the vendors listed: Dataproducts New England, General DataComm, Inc., Racal-Milgo and Timeplex.

■ **Framing.** D4 format and framing is essential. Extended superframe format (ESF) framing is desirable. A multiplexer that supports both of these allows users to take full advantage of current carrier T-1 offerings. Most of the truly advanced network management and diagnostics provided by carriers is through ESF private lines.

■ **Clocking.** What is the network timing source, and what happens if it slips or goes down? Can the multiplexer handle multiple timing sources from multiple carriers? Will the nodes, freed from synchronization, start freewheeling data into the network and bring it to its knees? How is the clocking restored, and how quickly?

Insinc's Baker suggests examining the size of the multiplexer's input buffers, which enable the multiplexers to handle some clock slippage or differences between network timing sources. Data coming into the multiplexer is typically brought in through a buffer. The time delay between receipt of the data and its processing to the buffer typically allows the multiplexer to compensate for any slight clock slippage. The disadvantage of using these buffers, however, can be transmission delay.

■ **Flexibility.** Since there are often internal design constraints in multiplexers, such as the number of cards, shelves, channels and nodes that a multiplexer can support, it's important to take these limits into consideration when evaluating products.

The accompanying chart lists the various types and numbers of data and voice ports supported, the maximum number of nodes and nodal links supportable by the multiplexer, and — most importantly — the types of network configurations supported. The more functionality contained in the multiplexer, the better off the users will be down the road as their networks change.

When questioning the vendor on flexibility, ask if port speeds can be changed without swapping out the relevant cards. As applications change over time, port speed requirements will also change. You shouldn't have to buy and install new cards every time this happens.

■ **Bandwidth management.** How does the multiplexer allocate bandwidth to accommodate network needs? Is bandwidth available only in 64K bit/sec chunks, or are subrate segments available where needed? Subrate multiplexing and subrate drop-and-insert capability are a good indication of this. Subrate multiplexing puts multiple data channels — typically, from 1.2K through 9.6K bit/sec — into one 64K bit/sec time slot.

Just as there is no perfect net design, there is no perfect mux for all needs.

▲▲▲

Listed in the chart are the number of 9.6K and 56K bit/sec channels each vendor's multiplexers can squeeze into one T-1 channel (or T-3, as applicable).

■ **Routing flexibility and programmability.** The multiplexer should be able to route traffic around outages and high-traffic links wherever and whenever needed. Such routing capabilities should also be user-programmable or at least provide user-selectable parameters for bandwidth use and routing, as well as channel and network reconfiguration.

The important point is to let your applications be your guide. Just as there is no perfect network design, there is no perfect multiplexer for all needs.

It's not wise to jump on just one technology. Successful, flexible networks will be made up of several types of transport technologies, such as T-1, T-3, ISDN or frame relay. Each will be applicable in a different way to a different application.

Letters

continued from page 31

col for file transfer via modem."

This statement is erroneous. There are at least two commercially available terminal packages that support Zmodem and at least one public domain package.

MicroPhone II Version 3.0 by Software Ventures Corp. and Smartcom II Version 3.2a by Hayes Microcomputer Products, Inc. both contain Zmodem and are commercially available. ZTerm Version 0.85, a public domain package, also supports Zmodem.

Mark Murphy
Senior programmer
Carelink Corp.
Irvine, Calif.

Users intent on migration

continued from page 2

users cited the difficulty of convincing top corporate management of the need to move to client/server systems (see graphic, page 1).

"Seventy-five percent [of the users] believe the industry hasn't done enough to explain client/server computing," said a Dun & Bradstreet spokesman. "They need to understand client/server better to be able to sell it to top management."

Technical issues concerning networking were cited by more than 11% of the surveyed users as the primary hinderance to client/server computing.

The survey identifies some of the same concerns cited in a report on client/server computing released in December by Newton, Mass.-based Business Research Group.

Among the problems identified by users in that survey were unproven technology, user dependence on existing systems and lack of defined standards for client/server computing.

Users contacted by *Network World* said problems facing net managers implementing client/server systems include the lack of sophisticated network management tools, the challenge of designing networks capable of handling the heavier loads imposed by client/server computing and a shortage of programmers with experience developing client/server applications.

Despite the obstacles, a majority of the Dun & Bradstreet users surveyed agreed that client/server technology will benefit their company within two years. "Client/server applications are being developed quietly in the Fortune 500 companies and, in some cases, in smaller companies," said Michael Howard, president of Infonetics Research Institute, Inc., a San Jose, Calif.-based market research firm.

"MIS groups are using the client/server architecture to implement applications that make those organizations more competitive and more productive," he said. "The applications flatten the organizations and move critical information out to the users."

For more information about the survey, call Dun & Bradstreet at (508) 935-3000.

DEC rolls out ASA Services

continued from page 13

X.500, can be employed with an authentication service such as Kerberos.

ACA Services' consistent application program interface enables it to link to existing applications. As a result, programmers do not have to know the commands, syntax and other features of the various applications that comprise a single distributed application.

Object-oriented technology is used to register applications and their capabilities with ACA Services, enabling applications to be shared and reused.

ACA Services runs under VMS Version 5.4 or later and Ultrix Version 4.2 or later.

ACA Services is scheduled to ship in September. Prices for the Developers Kit start at $450 for VAX operating systems and $950 for Reduced Instruction Set Computer (RISC)/Ultrix. The Run-time License starts at $110 for VAX and $150 for RISC/Ultrix.

Comparing global services

continued from page 25

Country VPN service to Canada and plans to begin Country VPN service to Australia, Belgium and — with KDD — Japan later this year. Country VPN service to Singapore is planned for the first quarter of 1992.

AT&T's Evans conceded that his company's bilateral approach has made Global SDN less feature-rich than GVPN. But he said that over time, Global SDN will support the same features GVPN supports. For example, AT&T may begin deploying switched 56K and 64K bit/sec capability in Global SDN late next year.

AT&T currently offers international switched 64K bit/sec service via its Switched Digital International (SDI) service, which is not integrated with Global SDN. But Burroughs said AT&T's SDI rates are much higher than US Sprint's GVPN switched data prices.

MCI, meanwhile, is struggling to catch up. The carrier currently offers international Vnet, its virtual net service, to the U.K. MCI plans to commence beta tests of Vnet service to Australia and Belgium in July, to the Netherlands and Unitel of Canada in September, and to France in November, according to Paul Nagy, MCI's international voice marketing manager.

MCI's international Vnet service is an analog, bilateral service similar to Global SDN. Nagy said MCI also plans to integrate switched digital capabilities into the offering, but he declined to say when.

Nagy contended that MCI is competitive with the other carriers in terms of countries and features supported.

He added that users are purchasing international virtual network services from the same carrier that supplies their domestic virtual net service, rather than playing carriers against one another.

Brokerage to build net

continued from page 1

The Clearing Corp., based here, clears trades by figuring out how much brokerage firms owe each other and arranging funds transfers.

It is owned by members of the Chicago Board of Trade.

Abandoning batch mode

Currently, brokerage firms clear trades at the Board of Trade by gathering paper slips from traders. The firms then enter trading data from these slips into trade clearing systems owned by the Clearing Corp.

According to Baker, 70% of all trades are entered into terminals that are linked via analog lines to the Clearing Corp.'s mainframe here. The remaining 30% are cleared via direct links between that mainframe and trade entry systems run by the brokerage firms.

With the latter, batch files of 500 to 600 trades are created and sent to the Clearing Corp.'s mainframe using remote job entry protocols, according to Stephen Goldman, the company's communications group manager. He said it can take the firms 30 minutes or longer to create these batch files.

ARCS will enable brokerage firms to communicate trade data directly into the Clearing Corp.'s mainframe using LU 6.2 protocols. This will eliminate the batch-related time delay and enable trading firms to quickly find out which trades matched.

In volatile markets, when prices change quickly, this time savings can be worth millions of dollars. Trading firms need to know quickly how much money they owe or are owed so they don't make deals they can't afford, Clearing Corp. officials said.

"The time savings is extremely important because of the volatility of these markets," said Alan Grody, president of Financial Intergroup Holdings, Ltd., a New York firm that helps exchanges build trading systems.

Future role

But ARCS will play an even more crucial role in the fully automated market that the Board of Trade will develop over the next two years when it is linked with trade routing and execution nets now being developed.

One net, the Electronic Order-entry System (EOS), is used to route buy and sell orders from brokerage offices to the Board of Trade's fault tolerant computers. The computers send the orders to the exchange floor where they are executed by traders. This net recently came on-line, and the Board of Trade is now bringing firms up on it.

The Board of Trade is also working with the Chicago Mercantile Exchange on Globex, an after-hours electronic trading network slated to come on-line this year. Globex will also route trading data to the exchange's computers.

Finally, the Board of Trade plans to deploy next year a net called Audit, which will support hand-held terminals that traders can use to route trading data via wireless links to the exchange computers.

The Clearing Corp. will use ARCS to obtain Audit, EOS and Globex data from the Board of Trade's computers, eliminating the use of paper slips to record trades.

This link will also enable the Clearing Corp. to route trading data to brokerage firms so those companies will no longer have to enter the data by hand.

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Pan Am's plan grounded

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the time, told *Network World* and other trade publications that the airline was expecting to award a five-year, $500 million outsourcing contract by early summer.

Wagner said Pan Am was planning to farm out management of its global network, applications development, data center operations, personal computer support and maintenance of all equipment worldwide. The deal would have given Pan Am a badly needed infusion of cash from the sale of its IS and network facilities and provided a safer haven for all 500 of Pan Am's IS workers.

The vendors named as contenders for the contract included Andersen Consulting, AT&T, Electronic Data Systems Corp., IBM and a French airline consortium called SITI.

But soon after Wagner tipped his hand, he resigned from his post at Pan Am to become vice-president of IS at Consolidated Rail Corp. in Philadelphia. When he departed, much of the enthusiasm and impetus for the outsourcing deal left also.

"The project was a good idea in theory, but it proved difficult to sell [to vendors] with us in Chapter 11," said Lawrence, a 20-year IS veteran at Pan Am who was appointed to replace Wagner.

"Vendors typically want guarantees of a steady revenue stream before they commit to a project," he said. "Honestly, most of the interest from [outsourcing] vendors was exploratory.

While vendors aren't currently rushing to nail down the $500 million outsourcing contract with Pan Am, many have expressed strong interest in acquiring parts of Pan Am's information technology infrastructure.

Lawrence said vendors have also shown interest in acquiring or using bandwidth on Pan Am's global private data net, which consists of a 56K bit/sec backbone that connects major hubs in the U.S., Europe, Central America and South America, with tail circuits to most major cities in those regions. The firm also supports a private voice network in the U.S. and some foreign countries.

But Lawrence may never get a chance to negotiate an outsourcing agreement. Several airline and travel-related companies have been maneuvering to acquire all or parts of Pan Am.

Last week, Delta Air Lines expressed interest in acquiring about one-fifth of Pan Am's assets.

Although Pan Am's Chairman Thomas Plaskett has publicly stated that he would only entertain offers from suitors that want to purchase all of Pan Am's assets, he expressed more than casual interest in Delta's offer.

A merger with another airline or travel-related company could drastically reshape Pan Am's IS and network operations, but Lawrence declined to speculate how a merger might affect Pan Am's IS operations.

"It's difficult to predict what another carrier would do with our network and systems because there would be some duplication," he said.

Domino's exec delivers

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What goals are you looking to achieve by being an active member of national and state user groups?

The main thing I'm looking for is to enhance my company's ability to do business and, secondly, to advance the state of the art. There's lots of potential in the new technologies, especially [Custom Channel Signaling System 7] and [Custom Local Area Signaling Services], that I think can benefit my company in particular and business in general.

I believe that caller ID services will prove useful to our pizza stores, but without the support of the National Centrex Users Group, which created a position paper in favor of caller ID, my voice may not have been heard.

The user group forum enables me to talk to other users with similar interests and present a united front on things like CLASS, a debate our National Centrex Users Group has been active in.

Taken as a single entity, Domino's Pizza has [limited] ability to promote CLASS features. But if I can prevent a united front with 10, 20 or 100 companies, my argument becomes much more persuasive.

Where in the evolution of user groups is the National Centrex Users Group?

We see ourselves as a mature organization. We want to be a leader in advocating the Centrex users' position and an educational force to let users know what's out there and how to benefit from it. In the past, we were in a formative stage. We were trying to ascertain what members' interests were and what direction we ought to be taking. We weren't as focused as we are now.

What kind of obstacles does the National Centrex Users Group have to overcome if it is to survive and thrive?

The biggest challenge is to make ourselves better known to the user community at large, to show the advantages of [the group] in an economy where telecom managers are increasingly being asked to limit their involvement in user groups.

We have to show users why we are an effective advocate for the Centrex position and why, if they have to pick just one or two groups, we should be on that shortlist.

What do telecommunications managers need to do to win support from their management to join user groups and take an active role in these organizations?

I think they need to illustrate, in terms that senior management can understand, why active involvement in a user group can help advance business issues. They have to give management good business reasons for joining and participating.

But frankly, if they can't do that, then involvement in a user group may not be a good idea.

What do you see as key trends in the telecommunications industry?

It's obvious that many vendors have been going after the truly large customer, giving them very attractive deals to lock into a multiyear contract. But that's even making its way down to the middle and low end of the market.

A key trend to keep an eye on is the changing user-vendor relationship. Vendors need increasingly to partner with customers to better address the customer's business needs. That needs to be more than a cliche.

The vendor needs, on occasion, to forget who he's working for so he can best represent the customer's interests.

What do account teams and sales representatives need to do to make their relationship with users more productive?

They need to understand the user's business. They need to spend some time learning all facets of the business. Account teams need to do more than show up at my office to talk; they need to visit our stores. The best of my vendors will even put on an apron and help out in a pizza store to understand the business. Other vendors need to do this as well.

It's not enough anymore to show up at the corporate office. They need to be talking to people in the field and, where possible, participate in the operation to understand what it's about.

Why isn't that happening today? Is there just too much emphasis on the quick-hit sales call?

The quick hit is part of the problem. It's been easy to go out and sell against a giant on price or to pick out the disgruntled customers and concentrate on them. Neither requires much of an understanding of the user's business. But easy pickings are over. It's time to work with the customer and earn the business.

What impact do changes in vendor sales forces have on customers?

When I lose an account [representative], especially when it happens without a transition period, it creates confusion for me and my users. It also means I have to train somebody on my business and my company's corporate culture all over again.

That means problems for me and problems for the vendor because if I have to retrain this vendor, I risk him alienating my users if the reeducation process doesn't go well.

IS initiative positions UPS

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to use IS for a competitive edge in the 1990s.

"I don't know of anyone that has made as rapid an expansion," said James Wetherbe, director of the MIS Research Center at the Carlson School of Management of the University of Minnesota at Minneapolis-St. Paul. "They were clearly underinvesting in IS [before 1986]. But UPS could see the writing on the wall. If you don't make the investment, you can't stay in the game."

Boardroom initiative

Prior to 1986, UPS' IS expenditures were minimal and its systems meek — largely in line with corporate policy, according to employees who worked in its IS department at the time.

"Users weren't happy. They thought our systems weren't competitive and weren't on the leading edge," said Frank Erbrick, UPS' senior vice-president for IS. "They were right."

Erbrick took over UPS' IS helm in 1985, as the company's 118th IS employee.

Before 1986, Erbrick said top management's aim was to spend as little as possible on IS. UPS ran antiquated applications on a single mainframe linked via a rudimentary, multidrop leased-line network to a handful of terminals across the country, company officials said.

But Erbrick said top management, led by UPS' current chairman, Kent Nelson, realized the company could no longer succeed by scrimping on IS. In order to remain competitive, UPS decided to roll out an array of new customer services that required a vastly expanded IS infrastructure.

Steven Heit, a UPS planning manager responsible for aligning IS and business strategy, said the company realized that more and more customers would be won through value-added services such as giving customers the ability to track deliveries and communication of shipment information via electronic data interchange.

But UPS needed to totally revamp its IS infrastructure because its existing facilities could not support these new applications.

The IS investments were also necessitated by changes in UPS' business operations. During the late 1980s, UPS expanded its international shipment operations from a handful of countries to 118. The company also purchased its own fleet of planes.

Both of these changes required new, networked IS to ensure that shipments and flights were properly coordinated.

End-user input

To effectively manage this IS expansion, UPS drew users into the planning process. The company convened a planning committee with representatives from each major business unit that prioritized systems development and decided how much money would be spent.

According to Erbrick, the committee drafted a five-year plan that called for expenditures of $1.5 billion on 18 IS initiatives. These included new billing, air fleet coordination, EDI and package tracking systems, as well as the creation of UPSNet, which the firm began deploying in 1989 and is now close to completion.

UPSNet routes data between minicomputers and personal computer local-area nets at more than 2,000 package sorting and administrative centers in the U.S. and 80 foreign countries, as well as at a $100 million data center UPS cut over here last month.

The network includes about 40 packet-switching nodes from Northern Telecom, Inc. linked over T-1 facilities using 11 Network Equipment Technologies, Inc. multiplexers.

The net carries data used in most of the applications developed in the five-year initiative, including EDI documents from customers, airplane coordination and package tracking data.

One of the most critical applications developed during this period is the package tracking system, which UPS began installing in 1986, Heit said.

Initially, the package tracking system was a bare-bones application. Bar codes, which were placed on packages by UPS employees, were scanned when the customer dropped off the parcel and again when drivers picked them up for final delivery.

This information was communicated to a central data base that service representatives in calling centers could access in order to answer customer inquiries about the status of package deliveries.

In 1988, UPS upgraded the package tracking system by sending images of delivery receipts over UPSNet back to a central image data base.

Service representatives can access images to verify deliveries and resolve disputes with customers. Erbrick claims that UPS is now one of the country's most advanced users of imaging technology.

UPS is upgrading the package tracking system further by giving its drivers custom-designed, hand-held computers, which they will use to record delivery information ("Hand-held computers will help UPS track packages," *NW*, May 6).

In addition, Erbrick said UPS is building a national radio network that, within a few years, will enable drivers to continously upload package delivery information. This will give UPS more timely information on deliveries.

Currently, drivers must upload delivery information from the hand-held computers into a central data base every night. Erbrick said the package tracking system was developed solely to improve customer service.

"If you think about it, 99.9% of our packages are delivered on time, so we really don't need this information," he said. "So why are we doing all this? The answer is that the public wants it."

The payoff

What's the payoff from UPS' increase in IS expenditures?

For one thing, the company has brought its IS budget more in line with other major users.

In 1986, UPS had revenue of $8.6 billion and spent about $40 million on IS — not enough to keep pace with rivals, according to Wetherbe. Now, he says, UPS' IS budget is within the norm for companies its size, which typically spend 2% to 4% of their revenues on IS. UPS had revenue of $13.6 billion last year.

But Erbrick said the most important payoffs from the five-year effort is that UPS is able to serve its customers better and that applications such as package tracking give UPS a competitive edge.

Also, he conceded that, in some cases, millions of dollars were spent on applications that had to be scrapped because they didn't work — although he would not detail any of those failures.

Erbrick also said UPS significantly exceeded its initial $1.5 billion spending target, although he declined to say by how much. But UPS officials say they had no choice other than to go ahead with the IS expansion.

"Without it, we would have been at a serious competitive disadvantage," said James Flynn, UPS' EDI services manager.

LAN linked to DOS-based PCs

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controlled environment as possible. It's easier to support an operating system with known hardware."

Ott said the company may eventually open up the interface to allow other vendors' cards to operate in the Great OS environment, but it currently has no definite plans to do so.

Despite its limited scope, the product received good reviews from beta users. According to Jack Gerken, senior vice-president at Cochrane Chase, Livingston & Co., an advertising and public relations agency based here, the software fits the company's needs perfectly.

"Peer to peer is ideal for our applications," he said. "We have passwords and security, but we generally have teams working on various accounts. If someone on that team goes on vacation, we'll still have instant access to information on that person's machine."

Gerken said the firm considered putting in a Novell NetWare LAN but decided on Gateway for several reasons. "NetWare was more than what I needed at this time," he said, pointing out that the company only needed a few personal computers networked together.

Although he would not say how much the NetWare system would have cost to install, Gerken said there was a substantial price difference between the two systems.

Great OS is available now in five-, 10- and 15-user versions costing $495, $795 and $995, respectively. By contrast, NetWare Version 2.2 costs $895, $1,995 and $3,495 for five-, 10- and 50-user versions, respectively.

RSA blasts NIST standard

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key algorithms. But Bidzos refuted that claim.

"It's a fact that the U.S. government does not need to pay royalties for its use of RSA," Bidzos said. He added that the NIST proposal falls far short of a complete encryption standard because it offers only the digital signature portion of encryption, not actual public-key message encryption.

Digital signatures only represent half a standard, Bidzos said.

Also, the digital signature proposal does not yet include a "hashing function," a mathematical technique used in conjunction with the digital signature to detect message modification.

"We observe that any proposed standard is literally worthless without one," Bidzos said in a written response to the NIST announcement.

Formal comment from other vendors about the NIST digital signature proposal is likely to come as soon as next month, when NIST is scheduled to publish the proposed standard.

Bidzos said several RSA licensees are now drafting a letter to members of Congress in protest of NIST's decision.

Industry backing for RSA's public-key algorithm is substantial. Systems experts at Fischer International and Digital Equipment Corp., both RSA licensees, said the company's encryption systems have proven the best available.

Other RSA licensees include Lotus Development Corp., Motorola, Inc., Northern Telecom, Inc., Novell, Inc. and Racal-Milgo. Apple Computer, Inc. and Sun Microsystems, Inc. may also join the RSA camp.

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Network World, Inc.
An IDG Company
Network World Headquarters:
161 Worcester Road, Framingham, Mass. 01701
Phone: (508) 875-6400/FAX: (508) 879-3167

Gary Beach - President
Mary Fanning - Dir. of Financial Operations
Nanci Farquharson - Adm. Assistant
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